PHOTO-ENGRAVERS' HAND-BOOK

— ON —

ETCHING & FINISHING

SECOND EDITION

A condensed treatise on the Etching and Finishing branches of Photo-Engraving; with Miscellaneous Chapters and an Appendix of practical examples, etc.
(Illustrated.)

BY

P. C. RAYMER

PREFACE.

The Photo-Engraving Process can hardly be called altogether old, nor yet entirely new, but the rapid advancement in improved methdos, widely extended uses, and varied resultant achievements surely entitles it to a place in the front rank of pictorial reproduction and educational progress. It is a work little understood by the average layman, and there is no vocation, perhaps, that requires a more inseparable combination of chemistry, art, and scientific skill.

While there are numerous books on photo-engraving obtainable, there is very little detail published in regard to the Etching and Finishing branches of the art, practically all dealing principally with the subject of "operating" or negative-making. That alone seems to be sufficient reason to justify the publication of this little hand-book. It is not intended as a complete encyclopedia of the processes, but rather as a guide and brief treatise in simple terms for the engraving student and apprentice in conjunction with their daily practical work. As such, it is hoped that it may be found valuable and useful. However, merely studying a book, or any number of books, without practical application, will not enable anyone to become a good photo-engraver. This accomplishment can be acquired only by patient practice and applied skill along with study and a keen interest in the work.

At the back of the book will be found an Appendix, showing a few simple examples of varied methods in commercial use, not for the purpose of depicting any extraordinary subjects, but merely that the reader may have a clearer conception of the matter described in the treatise. All plates were made precisely in accordance with the instructions given.

INTRODUCTION.

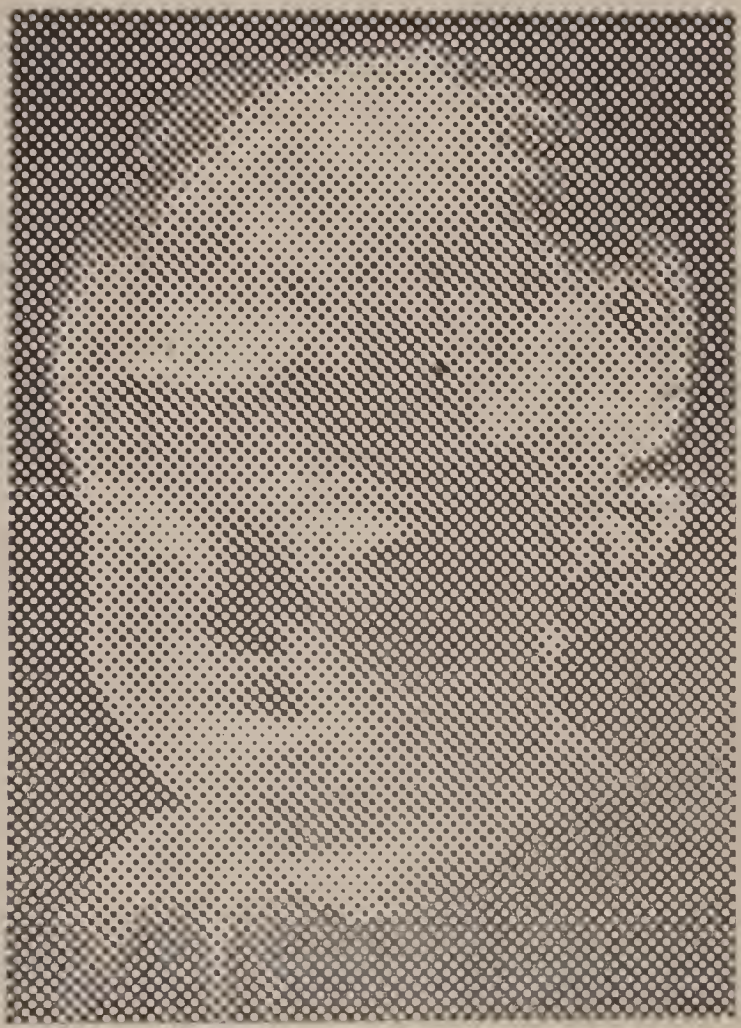
Before proceeding further, it might be well to describe briefly the negative and the nature of its requirements for our purpose.

Practically any sort of subject (termed "copy"), whether a line drawing (pen and ink), photograph, wash drawing, water color, oil painting, or even the actual object itself, can be quite faithfully reproduced by photo-engraving. The first requirement now to begin our work is that a suitable photographic negative be made from the copy. The negative is a photographic reproduction of the copy produced by the action of light reflected from the copy, through a photographic lens onto a silver-sensitized glass plate, the image on development being reversed as to light and shade, the whites on the copy being represented by corresponding portions of balck deposits and the blacks by transparencies. It is most commonly (practically always except for color process work) made by the "wet-collodion" method, which gives extreme contrast, perfect density in the opaque parts and at the same time perfectly clear glass in the unexposed portions when properly manipulated for our purpose. This negative is used for printing by the action of light onto sensitized metal for etching.

The "Line Negative" then (usually from a pen drawing in black ink on white paper) is very simple, about the only requirement being that the white paper be represented by perfect opacity and the black lines by perfect transparency, the lines also corresponding in breadth proportionate to those on the copy.

In reproducing the other subjects, however, where different degrees of light and shade are required, a negative of different character is necessary. This is called a "Half-tone Negative", and is produced by photographing the copy through a "half-tone screen", thus breaking up the variations of

light and shade into alternate solid and transparent dots of different shapes and sizes. The resulting half-tone negative depends on many different functions and scientific principles, especially those relating to "screen separation", "stops", and "exposure". Such details must necessarily be omitted here. A properly made negative, however, is essential for the best work, and it will be sufficient to describe briefly the main points of a properly made half-tone negative. One accustomed to the work will then quite readily understand what is required. First, the "shadow dots" (black dots of silver sulphide deposit in the negative shadows) must be quite small and very solid so as to not "print through" when subsequently printing by arc light. Second, in the "middle-tones" the dots must close together and join in suitable proportion and shape, a true middle-tone being of a chess-board pattern, but in all cases quite solid and opaque. Third. in the "high-lights" (transparent holes in solid silver deposit as usually found in sky portions, etc.), the dots must join strongly and overlap, giving strong opaque connections, leaving the transparent spots fairly small and just well rounded from the more nearly square in the next darker tones. That is, while at first glance one would expect to find them very small points of transparency corresponding in size to the shadow dots (as is required for "offset process"), the transparent spots must be slightly larger than that at least, for reasons which will be given under "Copper Etching". Experience in half-tone etching will soon teach the proper size and shape of high-light dots, and the operator should quite readily produce negatives of the desired quality by adjusting his high-light stop or exposure slightly. In all cases, however, all deposits of silver should be finally solid, and each dot and connection should be opaque enough to hold back entirely the strong rays of the arc light in printing onto the sensitized metal in later manipulations. Too much "cutting" can easily ruin a negative by weakening the dots and destroying the print-



Half-tone Negative.
(Enlarged.)

ing quality. In different screens, also, while the actual sizes of the dots will differ according to the screen ruling, the PROPORTIONS must remain the same. Half-tone negatives for zinc require smaller high-light dots than for copper.

The subject of "color negatives" will be touched on slightly under "Color Etching".

Many great things in science are simple when understood.

STRIPPING.

Stripping is the process of removing the negative film from its original glass support and transferring it to another, in order to reverse the image so it will print correctly, and also so several different negatives can be grouped upon one piece of glass so as to print and etch them all at the same time, thus saving a great deal of time and labor.

Coating the Negative.

After the original wet plate negative comes from the operator, it is allowed to dry thoroughly before we proceed to prepare it for stripping. The drying can be judged by the change of color through the glass side of the negative, and can be hastened by use of an electric fan or the even application of gentle heat. In this state it is merely an image of dried sulphide of silver on a thin film of collodion, separated from the glass by a substratum of albumen. It is therefore necessary to give it a more tough film or body so that it can be handled in stripping, which we do by coating it with rubber solution and plain collodion. The original collodion film being solvent in alcohol and ether, of which it is largely composed, the negative must first be protected with a coating of the rubber solution, or the fresh collodion poured directly onto the original collodion film would dissolve it and the image would run together into a confused mass. The rubber solution is flowed on the negative near one end and tilted to cover well with an even coating, draining off at the opposite corner of the plate, much in the same manner as the original collodion was handled in preparation of the negative. The rubber dries fairly quickly, but may be hastened by very gentle heat or use of a fan, care being taken, of course, not to allow dust or

other foreign matter to settle onto it at any time. When dry, the rubber still retains a sort of sticky feeling or "pull" when rubbed with the finger. The plain collodion, known as "Stripping Collodion", is now flowed over the rubbered negative in the same manner as was done with the rubber solution, but a little more care must be used, especially to prevent bubbles forming in the collodion bottle by allowing the collodion to drain from the negative directly into the same bottle. Either the rubber solution or the collodion can be drained off into their respective bottles if a little care and good judgment is used, but the most usual way, especially on large work, is to drain them into other bottles kept for the purpose; then when properly thinned down the solution can be used again. (The rubber can be thinned for use again by the addition of benzole or benzine, bringing it to the proper consistency, and the collodion can be thinned by adding 1 part Denatured Alcohol and 2 parts Ether, to the proper consistency. Both should be refiltered before using.) After the negative has been flowed with collodion it can be placed in a rack to dry, or may be dried quickly (after allowing it to just begin to "set") by gentle heat, or by touching a corner to a flame and allowing it to burn off. Care must be taken, of course, not to get the glass too hot or it is liable to crack. Also, before the stripping collodion was poured on, the negatives must have been almost cool or bubbles would be very apt to form on the collodion coming in contact with the over-warm plate. The negative now has a tough skin-like coating, which allows stripping and handling quite readily.

Stripping Bath.

As yet, however, the film adheres to the negative glass on account of the albumen which was originally used to coat the glass on which the negative was made. The albumen is dissolved by placing the negative in an Acetic Acid bath, sometimes called the "soak", for a few minutes. The film, or negative, can

now be stripped from the original negative glass onto another support where desired. In practice, several negatives are generally grouped together on a large "flat" or "stripper" in order to save time and labor in the printing and etching which follows. When the negatives are ready to trim up or cut for the acetic acid bath after the collodion is thoroughly dry, the trimming is done according to the requirements of the job, a sharp knife being used for the purpose. Line negatives are cut free-hand around the work, with about ¼ inch margin around the actual design, the point of the knife cutting through the film to the glass. Square half-tones may be also cut free-hand a little larger than the required finished plate if no border lines are wanted, but if a line is wanted they must be cut true and straight to actual size wanted or about 1|32 inch smaller to allow for line. Ovals are treated in the same manner: if no line is wanted, the half-tone negative can be cut free-hand, (being sure to cut large enough to allow for trimming down true), but for "oval with line" an oval "cut-out" form or ovaling machine must be used to cut the film to size and shape required. When the negatives, after being trimmed, have been placed in the acetic acid to soak, we can prepare the "stripper" to receive them. The stripper is well cleaned and placed still wet on the stripping table in a flat position. so that most of the water will remain on the surface. The stripping table is usually a raised glass surface (ground glass is best) lighted from the under side by electric lights or daylight so that the light will reflect up from the white surface, which is usually a white paper placed beneath for the purpose through the glass top of the table to aid in handling and placing the negative films. The glass top is best set at a slightly sloping angle toward the workman, so that any surplus water from the stripping operations will flow off instead of stand in puddles as on a level surface. In this case, of course, the stripper can be leveled by a loose

strip of wood being placed under the near edge.

Transferring and Reversing.

After the negatives have soaked a few minutes, they may be tested for stripping. If they have remained in the "soak" long enough, the outer margins or waste films can be peeled off with the fingers. This waste film may be all cleaned off if desired, especially if we intend to use the same glass as a stripper, and is usually saved as silver waste. The acid is now well rinsed off the film, and the negative laid face up with one edge resting on the far edge of the stripper. The stripper must be kept fairly wet with water where we intend placing the negative. The thin blade of the stripping knife is now placed carefully under one corner or edge of the film, and with a thumb or fore-finger pressing on top, the film is gently stripped back far enough to grasp with a thumb and fore-finger of each hand. The stripping is continued back over the original negative glass, until the negative is completely transferred to the stripper. The rest of the negatives are stripped in the same manner, being sure to reverse them, that is, turn them over so that they will be in the same direction as the original copy as regards left and right. The lens reverses the copy in making the negative, so we have to reverse it in stripping or the finished etch would print backwards. The stripper being wet, the negatives can be slid around into suitable position and grouped to form a fairly square or rectangular flat, so as little metal as possible will be wasted by irregularities in fitting. We must, however, leave at least ¼ inch between the negatives to facilitate separating the finished etchings by cutting between with the saw or outer bit. Small groups or single jobs can be blotted off at once into position, but large groups, or large films which are apt to stretch out of shape, are best covered with a sheet of wet paper and "squeegeed" off to remove most of the surplus water from the films.

The paper is now lifted, and small squares of clean blotter are used to blot off and dry the negatives, starting at the centre of the film and working the water out carefully to the edge and there blotting it off. All water must be removed so that the film will lie smooth and flat on the glass, where it will adhere spontaneously when thoroughly dry. What water remains on the stripper around the negatives can be blotted off, the back of the glass is wiped clean and dry, and the stripped flat of negatives can be put away to dry thoroughly for printing or perfect drying can be insured by gently warming from the glass side. The negatives must be thoroughly dry and slightly warm before printing onto the sensitized metal. If the negatives are to be printed in a hurry after stripping, they can be dusted over lightly with French chalk, talcum powder, or powdered magnesium carbonate. This tends to absorb any slight trace of moisture, and prevent the negatives sticking to the sensitizer on the metal.

Difficulties.

A few difficulties might be encountered by the inexperienced stripper, the most common of which might be given brief mention here, along with preventive suggestions and remedies. In coating the negative with rubber, the solution must at least cover the entire image or design, or the stripping collodion will dissolve the unprotected parts and run them. The stripping collodion also must cover the whole job, or the part covered only with rubber on being stripped from the glass support will "shrivel" up into a tiny wrinkled mass and consequently be parts and ruin them. The stripping collodion can be burned off quickly, do not attempt to burn off the rubber solution to hasten drying the rubber in burning will badly smoke and stain the negative, besides bubbling it into a useless mass. Warm the rubbered negative very gently if necessary, but it must be allowed to cool well again before flowing on the

collodion. Also, negatives are sometimes caused to stick (in stripping) by coating with collodion before the rubber is dry: Also by too much intensification in the "operating".

Large negatives that are liable to become stretched out of true shape or size, especially such as maps, architectural work, etc., may be flowed twice with collodion, draining at opposite corners each time to form an even heavy coating. If desired, they can also be stripped with the aid of wet papers in the following manner: place a sheet of wet paper onto the soaked negative and strip both paper and negative off together; transfer film onto another wet paper, and from that onto the stripper or flat. The second wet paper is used in order to reverse the film. Squeegee down and blot off as usual. Large negatives are more apt to stretch out of shape than small ones, but in any case too hard pulling on the film should be avoided. Replace negative in the acid bath and soak longer if necessary. If the collodion is flowed on twice, the first coating, of course, must be dry before the second coating is given.

Occasionally the film might curl up off the glass after being stripped. This is generally caused by not enough castor oil in the collodion, or even an inferior grade might sometimes cause this effect. The use of the oil in the stripping collodion is to render it flexible and enable it to lie smooth and flat onto the glass so it will adhere well. The remedy is to add more castor oil (or a better grade) before using it again. The lifted edges of film may be fastened down into place with a little thin glue or white of egg, and squeegeed again.

Nothing succeeds like success.

METAL-PRINTING

Zinc INK Printing—For line work on zinc, the method in general use is called the "Ink Process", also well known as the "Dragon's Blood" Process, which is inexpensive and very satisfactory. It is also used considerably on course-screen zinc half-tones, especially newspaper work.

Sensitizer

The first point to consider is the Sensitizing Solution, with which we coat the metal to enable us to transfer the image (in positive) onto its surface preparatory for etching. This solution is mixed according to the chosen formula, the chemical action of the ingredients being chiefly as follows: The water is used as a solvent and is also the basic liquid to give quantity. Bichromate of Ammenium or Potassium is the sensitizing agent proper. It has the peculiar property of rendering insoluble in water an organic matter in mixture with it when the mixture has been exposed to the action of strong white light for sufficient length of time. To furnish the required organic matter we use glue and albumen. The glue also helps the image to develope more easily and cleanly. The ammonia is used chiefly as a preservative, although its slight chemical action makes the solution a little more sensitive and also helps development to a small extent. A most simple and convenient method of mixing the solution is to first measure the required amount of water into a graduate, the bichromate into a mortar for grinding, and the albumen into the mixing bowl. Now add a small quantity of the measured water into the bichromate, a small quantity to the albumen, and into the remainder of the water in the graduate mix the required amount of glue. Mix the glue solution thoroughly, grind the bichromate in the mortar well, and beat the albumen (using

a rotary egg beater) into a stiff froth. Now add the glue solution, beating well to insure thorough mixing with the albumen, and then the bichromate, again mixing it well in. Lastly, the ammonia is added, and the whole again beaten well to a frothy mixture. It is well to let the solution stand a half hour or so to let the foam settle before filtering, but if desired it can be filtered and used at once. The filtering is done through dry absorbent cotton, and care should be taken that no bubbles form in the bottle, as such bubbles break very slowly and cause trouble in coating and printing the metal. The solution works better. and also slightly faster, after a day or two old. This is especially true of Enamels.

Polishing

A special pure, smooth-grained zinc is used, bought ready polished in large sheets of suitable thickness. The most common thickness uesd is 16 gauge, although some 18 gauge (slightly thinner than 16) is used for special purposes. The zinc sheets when bought are covered with a thin greasy substance to protect the metal from the oxidizing action of the air until ready for use. This coating must be removed by re-polishing, wth charcoal or powdered pumice, which leaves the metal with just enough grain or "tooth" to help hold the sensitizing solution, besides cleaning the surface for an even action of the etching solution. If charcoal is used, it is held so that the cutting or polishing is done against its grain; that is, one end of the charcoal stick is rubbed down to a rounded angle, this angle (the end of the grain) being used as the cutting surface. The charcoal is usually rubbed across the zinc in long full strokes in the direction of the original polish of the plate in its manufacture, keeping the plate wet under the tap during polishing. Occasionally it may be found necessary to first polish across the grain of the plate to remove fine scratches or other irregularities, and then finish up with the grain. If pumice is used,

it is applied to the metal with a pad of heavy felt, or a piece of Brussels carpet tacked around a small block of wood, rubbing firmly against the metal plate and kept slightly wet during polishing. After polishing, the plate is rinsed well under the tap to remove all charcoal, grit, or other foreign matter, and is now ready for sensitizing.

Coating the Metal

The sensitizing of the metal is done with the aid of a "whirler". A whirler is an apparatus in which the plate is fastened and made to revolve over a gentle heat to permit even and rapid drying of the sensitizer. If the ordinary hanging whirler is used it is best to place the plate in the whirler before coating it with the sensitizing solution, but with the mechanical whirler the solution must be flowed on first. The wet polished surface of the plate is flowed over with the sensitizing solution, much in the same manner as in albumenizing negative glass. The plate is held with the left hand, but resting on the tips of the fingers face up, instead of being held by the corner. The first flow of solution is worked over the entire plate and drained off the lower corner, chasing ahead of it the surplus water with which the plate was rinsed after polishing. A second flow of the solution is given carefully, covering the whole plate and draining off as before. The solution drained off from the first flowing is always thrown away, as it contains a great deal of surplus water other than that used in its own mixture, but the second flowing may be drained back into the same bottle if care is taken not to allow bubbles to form in the bottle by doing so. In this case, the bottle must be tilted so as to allow the solution to flow smoothly down its side and not cause bubbles.

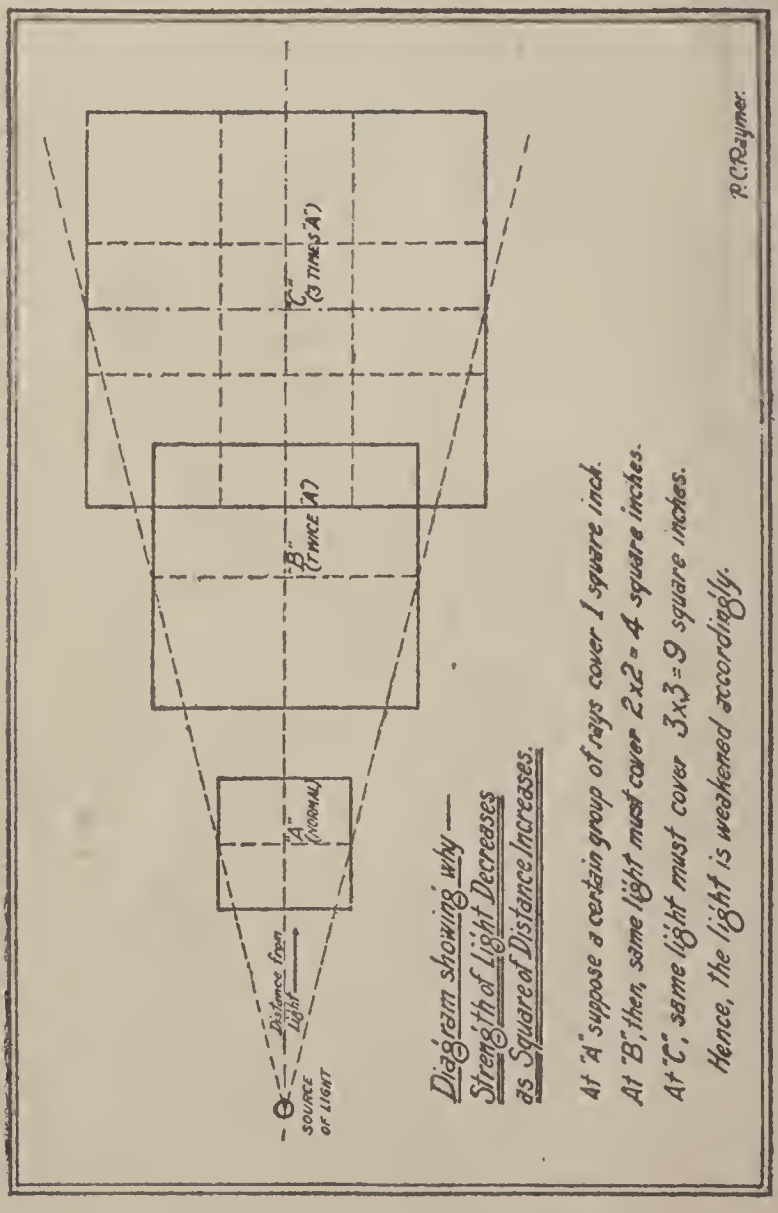
The plate is now whirled face down over the small heater, and a short distance (6 inches to 1 foot) above it until the sensitizer becomes dry. When dry, the back of the plate will feel warm to the hand, but care must be

taken not to over-heat the sensitizer or it is apt to become tough and clean development of the print later will be impossible. The proper speed of whirling depends on the size of the plate and also on the thickness or consistency of the solution, and easily determined after a little experience. A small plate will require faster whirling, usually, than a large, as the edges of the small plate would have to travel more revolutions in the same time to attain the same lineal speed, or centrifugal force, as the larger plate. It is best also not to whirl the plate face down over an open flame; the heater should be covered with a piece of old zinc or other metal so as to protect the sensitizer from the direct gases, etc., from the flame. After taking the plate from the whirler, it is allowed to become cool, or almost cool, before printing under the negative in the printing frame. The coating, whirling and cooling operations must, of course, be done in the dark or a weak light (or yellow light,) as the coated surface is now sensitive to any strong white light. The solution, however, is practically insensitive until it has become dried.

Printing

The "Stripper", containing the stripped negatives, is placed in the printing frame, glass to glass, or film side up, and the sensitized zinc is placed in position on same with the sensitive coating in contact with the films. If preferred, the stripper can be placed on top of the coated metal out of the frame entirely, and the both "flipped" over together and placed into the frame. Care must be taken not to tear or "slug" the negatives, especially in half-tone work. The padding and back of frame are now placed in position on top of the metal, and the frame is tightened down well to insure perfect contact. No grit or dirt of any kind must be allowed to come between the two glasses or the stripper and metal, as a very small particle will sometimes be sufficient to cause uneven pressure and crack

the glass, either the heavy frame glass or the stripper. It is well on large work to bend the metal slightly the sensitized side being the concave, so that the plate will rest only on its two edges until the pressure of the frame brings the centre into even contact, thus avoiding danger of slugging. The printing can now be carried on in the sun (in summer)



or by arc light. The frame is placed in position and the sensitized metal exposed through the negatives to the light for the proper length

of time, according to the sensitizer formula used, the strength of light, and the distance of the frame form the light. Sunlight, of course, gives a good even light over the entire frame regardless of size but its strength varies so from day to day, as well as according to the time of day, while the arc light is more uniform and we can feel more certain of results. The frame, however, should be placed at a distance from the light at least equal to the diagonal of the plate being printed. This is done to get even lighting over the plate, and if the frame is too close, while it allows of shorter exposure over the central part of the plate, the corners will be underexposed and will not likely hold well in developing up the print. A good rule to remember is: the strength of light decreases as the square of the distance increases; thus: a print requiring 1 minute exposure at 1 foot distance would require 4 minutes (2x2) at 2 feet distance, or 9 minutes (3x3) at 3 feet.

Developing

After the exposure has been completed, the printing frame is again turned face down and opened, the back removed, and the plate taken out to the rolling-up table. With a large Composition roller of good quality, or a fine nap lithographic roller, the sensitized coating of the plate is rolled up with a thin even film of Etching Ink. This is a slow-drying ink made especially for the purpose, and has adhesive qualities which permit any fine powder sticking to it quite readily. A little experience is required to know just what amount of ink should be used. Over-inking should be avoided, as this will tend to thicken the lines of the print and also cause it to not develop out well. The best results are generally obtained when the ink is just heavy enough to show from a deep olive color to black. The rolling-up, as well as the sensitizing, should not be done in a strong light. After rolling-up, however, the print is practically light-proof, and can now be developed

up in stronger light without danger. The inked print is developed under a tap or in a tray of water, aided by lightly swabbing over with a tuft of soft clean cotton. The water can be warmed considerably if necessary to help development, or a few drops of ammonia may be added to the water. As explained above, the strong light acting on the ammonium bichromate in mixture with the glue and albumen renders the mixture insoluble in water. In printing, the action of the light through the clear parts lines etc. of the negatives has rendered those portions insoluble in water while the parts protected by the dense black background of the negatives were not hardened by the action of the light and are therefore soft and easily washed away under the tap during development, carrying with them their coating of etching ink. After the print is thoroughly developed and rinsed clean of loose ink, it is dried by patting gently with a soft moist chamois followed by slightly warming over the stove. In using the chamois, the print must be patted carefully, not rubbed, or the result will be a dirty, smudgy print.

Topping

The print is now touched up, or spotted, for defects, using etching ink thinned very slightly with turpentine, painting up with a small brush all breaks and defects in the ink-printed design. A "bridge" or "rest" is used to raise the hand off the work while painting up, so as to not smudge the print. The background, called "dead-metal", is also now painted up roughly to about ¼ inch from the lines of the print. This painting up of the dead-metal effects a great saving of acid as well as lessening the fumes given off. It also helps considerably in powdering evenly and holding fine lines during etching. When all painting and touching up is completed, the plate is dipped into a box or tray of fine resinous powder known as "Topping Powder", rubbed over carefully with a tuft of cotton

so that the powder will adhere well and cleanly to the ink, and brushed well with a soft broad brush to clean the bare metal of topping powder leaving a good coating of the powder sticking to the inky lines of the design. It is best to warm the plate slightly before topping, which tends to soften the ink just enough to hold the powder well and allows better cleaning of the clear spaces. The plate is heated gently after powdering until the powder changes from a gray color to black, showing that it has melted and combined with the ink design, forming, when cooled, an acid-resist top ready for the first "bite" in the etching solution. The print must not be heated too strongly, or the lines will spread and thicken, making the whole design heavy and smudgy in comparison with the copy. Zinc, when heated to an excessive degree, will easily melt, and in any case will cause the metal to weaken and become grainy or brittle. Just enough heat should be applied to darken the topping powder and fix it into the ink design, being sure however that it actually melts together so as to make a solid impervious "top", yet without heating enough to spread.

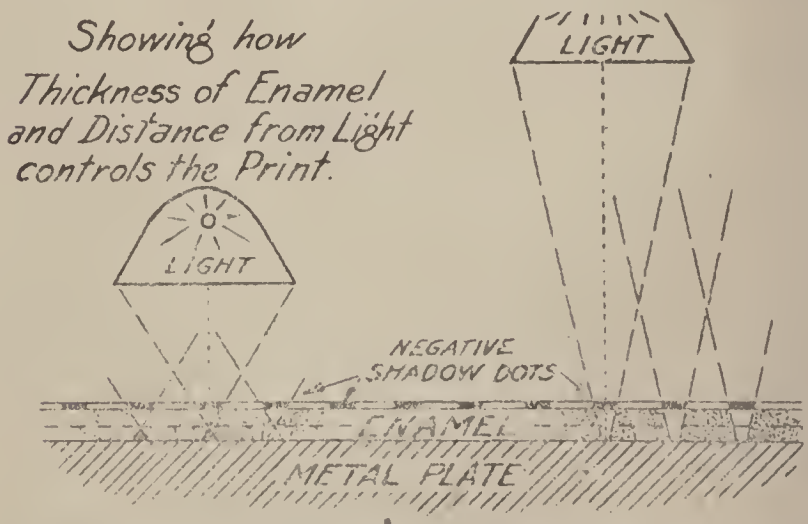
While the print is still hot, it is stood against a wall or other support, and the back painted over with asphaltum or heavy shellac to protect the back of plate from the corroding action of the acid during etching. Asphaltum is most commonly used, as it is much cheaper and more acid-proof than shellac. When cool, the plate is ready for the etch.

Zinc ENAMEL PRINTING—The Zinc Enamel process is used in some workrooms to a great extent, while in others it is not used for any work whatever. It is used considerably in half-tone work on zinc, especially when 85 line screen or finer is used on zinc, and also in some fine line work, but is not always so certain of holding well as in the Ink method. It does not require rolling up with etching ink, however, and usually works cleaner on

fine work; so where great depth or much etching are not required it is very practical.

The Zinc is polished and prepared the same as for use with the Zinc Sensitizing Solution and Ink process, rinsing the plate under the tap afterwards to remove all grit and foreign matter. The wet polished surface of the metal is flowed over twice, as before, draining the first flow off and the second flow back into the bottle if desired; but in this case Zinc Enamel is used instead of Sensitizing Solution, which latter is much thinner and more free-flowing that the Enamel. The Enamel, therefore, must be flowed carefully and evenly and more judgment must be used in the whirling.

After the enamel-coated zinc has been whirled dry and cooled slightly, it is printed under the negative in the printing frame just as was done with the ink process. Usually, however, the enamel requires longer printing time than the thin sensitizer.



The exposed plate is removed from the frame and developed under the tap at once, without any rolling up. A spray nozzle on the tap makes an excellent "squirter" and aids materially in the clean development of the print. If necessary, after spraying under the tap, the plate may be laid in a tray of warm or fairly hot water to develop out thoroughly. This dissolves away the fine fuzzy connections

which sometimes tend to fill up the print, especially noticeable on half-tones, and cause a dirty appearance in the finished work. The print can be examined well by flowing over it a dye solution, which colors the enamel on the metal and washes away easily from the cleared metal, thus showing the print clearly and perfectly as it is on the metal. The dye has no function whatever in the actual developing of the print, only serving to help judge the work. Any holes, dirt, or other defects in the print may now be seen distinctly, and if too bad it can be scrubbed off and be re-printed. If the print is satisfactory, it is well rinsed and "hardened" to better withstand the action of the acid in the etching process. The hardening is done best by soaking the print for about five minutes in a tray of Enamel Hardening Solution (see formula), allowing plenty of time for the solution to act through to the metal. The print is then well rinsed off under a tap, and dried over the stove very carefully in the following manner.

In drying, the plate is held by one corner with a pair of pliers the opposite corner being held over the stove and raised slightly so as to tilt the plate the surplus water running to the opposite corner. The top corner is heated slowly and as it dries the plate is slowly moved forward, allowing the heat to gradually and steadily force the water back to the lower corner. The water or moisture must not be allowed to form in a drop or "lake" on the plate as the print dries around it, as it is almost sure to leave a dark uneven spot and spoiling an otherwise good print. The heating is continued after drying, the dye burning off, then the print begins to darken until it becomes of a very dark brown color over the entire plate, in an even color of light and shade. The plate is quickly removed from the stove and laid face up on a stone or iron slab to cool gradually. Never plunge a hot enamel plate under a tap to cool it quickly, as this practice will cool the enamel too suddenly and weaken it, and

also will render the metal tough and hard to work. When cool, the plates is touched up with "staging ink" and burned in (tested by a sizzling when touched on the back of plate with a wet finger), and then painted on the back with a good coat of shellac. When it has become cool again, the plate is ready for etching.

Copper ENAMEL Printing—Copper Enamel Printing is handled precisely the same as Zinc Enamel, excepting, of course the print is made on copper instead of on zinc, and Copper Enamel is used as the sensitizing agent and resist top instead of zinc Enamel. Also, usually no hardener is used after developing the print. Some workers use it, but it has a tendency toward brittleness and working with less smoothness. Few additional instructions are necessary, but the following will be beneficial.

In polishing copper some workers prefer to rub in a circular motion or in small rings over the whole plate, especially if using charcoal. A good soft grade of charcoal should also be chosen for this purpose. The direction of polishing may be left to the choice of the workman as either the circular or longitudinal motion will give equally good results so long as a good even polish is obtained.

The copper enamel should be burned in to a rich chocolate brown. After laying on the cooling slab it still gradually darkens slightly while cooling, as the copper holds heat for a considerable time. The highlights also, on a very good print, will then turn to a silvery color or slight pinkish tint during cooling. Forced cooling is bad for the enamel and copper, and should be avoided.

The copper print is usually backed with very thin shellac, thinner than used for zinc although paraffin wax can be used while the plate is just warm but is not so good. Paraffin is very apt to cause trouble by getting on the face of the plate during burning in the staging, etc., thereby causing bad spots in

the etching. After spotting, or touching up with "staging ink", the plate is ready for cleaning preparatory to etching. (Copper Etching.)

A Few Enamel Difficulties and Causes.

(Remedies suggest themselves.)

Thin spots thin enamel, etc. = poor flowing or too fast whirling.

Thin spot in centre usually suggests too fast whirling.

Thin spot near corner suggests poor flowing or too sudden draining of first flowing, leaving some water mix with enamel.

Soft enamel (develops off)—over entire plate, = underexposure in printing, or too thick enamel.

Soft enamel (develops off—at corners only,= whirler too low (too close to whirler heater) or frame too close to light in printing; or enamel heavy at corners due to improper whirling.

Solid or filled-up shadows (in half-tone), = over-exposure, thick enamel, frame too close to light, weak negative, lack of contact, etc.

Dirt spots, =usually dirty enamel (or dye): Re-filter or mix new.

Enamel lifting (during etch), = thin enamel, insufficient polishing, first flow drained off to suddenly, not properly rinsing off before flowing with enamel, too strong scum-clearing solution, too acid, or not rinsing clearing solution off well. Usually not thoroughly clean working somewhere. Seldom a really good excuse for it.

„For his heart was in his work, and the heart giveth grace unto every art. —Longfellow.

ZINC ETCHING

Tub etching is the most suitable method of etching zinc by the inexperienced workman, as by this method the progress of the work and the action of the acid on the metal can be watched and understood well. It is the method in most general use, although etching machines are becoming more popular all the time on account of their speed and clean working qualities when properly handled. But the etching action cannot be so well noticed, yet the principal is entirely the same as in the rocking tub etching, so at present we will consider only the latter method.

The Acid Bath

The principal of zinc etching is based on the fact that nitric acid etches or dissolves zinc, and the design on the zinc plate is composed of acid-proof material, being a combination of greasy etching ink and resinous topping powder in making the print. The bare zinc, which is free from such acid-proof protection, is acted upon chemically and dissolved by the acid solution, the plate being rocked back and forth in a large tray-like tub containing the acid solution.

The strength of acid solution and the time of etching is governed by the character of the work. The acid for the first "bite" is generally composed of about 1 part Nitric Acid (Commercial, 38 per cent) to 12 or 14 parts water, and about three minutes will usually be found sufficient time for this etch under these conditions. Just enough etching solution should be used to flow over the plate well and evenly when the tub is rocked, allowing the plate to be exposed to the air as the acid washes to either end of the tub. The fastest and smoothest etching is obtained during this time the chemical action of the acid in conjunction with the oxygen from the air oxidizing or corroding the zinc with a fine

satin finished surface. As the plate is rocked back and forth, a fine scum of tiny bubbles forms on its surface. This must be carefully brushed off from time to time with a flat bristle brush, leaving the etched surface bright and clean. It is important to keep the surface smooth and bright without brushing it enough to cause "undercutting" or loss of fine details. The etching is watched carefully, the tub kept rocking continuously, and the etching surface brushed smooth and clean as the oxide forms, thus keeping a smooth "bottom", as the clear metal surface is called. Practice alone will show the right amount of brushing required. At first the acid can etch in only one direction, that is downwards, but soon a fine bright edge appears along the sides of the lines and if the etching is then carried much farther it will begin to "under-cut" or work under the inked surfaces. It can easily be carried too far, but this should be skillfully avoided. On fine line work, of course, the etching on the first bite must be stopped sooner than on coarse work. When the etching has been carried far enough to allow just catching with the finger nail slightly when tested on the lines or dead-metal, there will be plenty of depth for the first powdering of Dragon's Blood powder. The plate is now removed from the acid and quickly rinsed under the tap, then can be dried with the chamois and warmed slightly over the stove.

4-Way Powdering

'Dragon's Blood" is a general trade name applied to an acid-proof resinous powder used in zinc etching to protect the sides of the lines, etc., from further etching while the background is being etched away to a suitable printing depth for the printing press.

The plate, while just warm and perfectly dry, is now dipped into the drawer or tray of Dragon's Blood, picking up a good quantity of the powder at one edge of the plate and sliding it, by tilting, to the opposite edge and back into the tray. What powder remains on

the plate is now brushed carefully in one direction toward where the powder was slid off using a broad soft hair brush (fitch hair or thick camel hair), holding the brush at an angle of about 45 degrees to the plate, pressing firmly enough to bank the powder against the sides of the lines. Those etched sides of the lines, (the sides facing one edge of the plate only), may be examined carefully with a magnifying glass or a linen tester if desired to see that no small breaks or pin holes are present in the powder, as the smallest pin hole will be large enough to admit the acid solution to the metal line and cause a ragged or broken line in the finished work. With practice and care it is seldom necessary to examine so closely after powdering, as when a skilled workman becomes accustomed to the work he will have a reasonable amount of confidence in the security of his powdering. The main point is, we must have a solid even line of Dragon's Blood powder pressed against one side of all lines, dots, etc., of the design, from powdering in one direction, and at the same time have the etched sunken surface of the metal brushed clean and free from powder. When this is done, the plate is carefully placed on the stove so as to not jar the powder from its place, and heated just enough to melt the Dragon's Blood against the lines, changing it from a bright red color to a deep brown or almost black. This requires more heating than to fix the topping powder in preparing the print. The plate is then rolled over a wet roller, made for the purpose, to partially cool, wiped dry on the back, and after noting that the front or printing surface is also thoroughly dry and just very slightly warm, it is ready for the second direction of powdering. The plate is dipped into the Dragon's Blood and brushed over in one direction exactly as before, excepting this time in a different direction. After this powdering is burned in and partially cooled as before, the third and then the fourth powderings are given, each powdering being done in a different direction, or

started at a different edge of the plate. Any order of powdering may be used, but it is best to powder the same directions always in the same order, such as: left, right, top, bottom. If the plate is one in which all sides of the design are nearly alike so that it is difficult to remember which sides have been powdered and which not, then one edge must be marked "top" or some other distinguishing mark, or one is apt to powder two or more sides twice and the other sides will be missed entirely, giving no protection to those sides of the lines. After the four-way powdering has been completed, each powdering being burned in before the next is given, the plate is ready for the second bite in the etching tub.

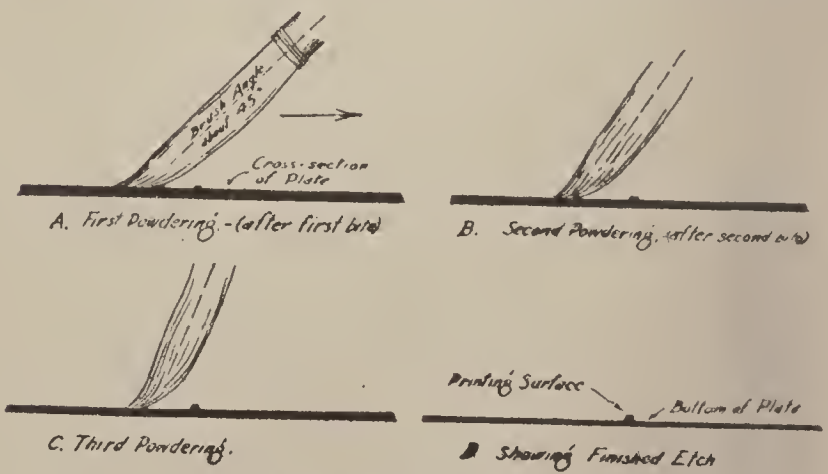
Some etchers prefer, especially on fine work, to give a fifth powdering; that is, powder four ways as usual, then turn the plate and re-powder in the first direction, thus giving the first powdering an extra coating for safety. This is done, however, only after the first bite, but is left to the choice of the etcher whether he wishes to follow it at all or not.

Successive "Bites".

The second bite may be given in the same acid solution that was used for the first bite, without increasing its strength, but a little acid may be added if preferred. The plate is rocked and brushed occasionally as in the first bite, taking care to keep the bottom of the etch clean and free from heavy scum collection without too much or too hard brushing. Let a thin layer of scum form on the surface, then brush lightly over the plate to remove it, repeating the operation only when necessary to keep the etch clean. When the bottom edges of the lines begin to show bright again, the etching must be watched more carefully again, and when it appears that it cannot be safely taken any farther, it is removed and dried as before, and powdered for the next bite. The operation is repeated, adding a little more acid for each bite, bringing the strength up to from two to three parts acid to 12 parts

water. Usually about four bites (three powderings) are sufficient to obtain a good printing depth, or until the plate is etched about one third or half way through its thickness. If necessary, however, an extra bite or two may be given, as is often the case on fine work, powdering four ways after each bite, giving protection to the sides of the lines for the following bite. Care must be taken during the whole etching to keep the bottom brushed free from scum as it forms, not using too hard or harsh brushing, of course, and also to bank the Dragon's Blood powder well against the lines, melting it well in to form a clean even acid-resist, and at the same time keeping the bottom brushed clean and free from the powder. The fine details must be watched carefully that they do not "undercut" or even lose entirely. Work in which the lines are close together does not, as a rule, require as much depth as where the lines are far apart, as the close lines act as support for the printing press rollers in printing from the cut, thus preventing the paper from "smudging" on the bottom of the etching.

It is well to note that each successive powdering (that is, four ways after each bite)



Illustrations showing Brush Angles during successive powderings.

is best done with the brush held more straight and firm than for previous bites. As the de-

sign is etched deeper and deeper, the powder must be banked against the lines more firmly and less sloping along the etched edges in order to avoid a broad rough "shoulder" on the finished work. Too much shoulder on an etching makes poor and difficult printing, as well as poor electrotyping if the plate is to be electrotyped.

Cleaning the Plate.

When sufficient depth is obtained, the plate is heated quite hot and immediately flowed over with a strong solution of ordinary lye or potash. This sudden contact of the lye and the hot plate lifts the ink and powder coating, and with the aid of a stiff brush the plate is scrubbed clean and bright. The lye is then thoroughly rinsed off under the tap, and a solution of old perchloride of iron (used in copper etching), or copper sulphate, is poured over the plate, the chemical action which takes place immediately giving to the zinc a dull black surface, which helps materially in routing and finishing up the plate. The top or printing surface of the design is now rubbed over with a stick of charcoal, which leaves the details of the design standing out in bright relief lines on a dead black background. After rinsing and drying, the plate is ready to be routed, blocked and finished for the printer.

"Cleaning Bite".

Some etchers will occasionally remove any excess shoulder from the etched plate by re-topping and brushing briskly in the etching tub a short time. This "cleaning bite" is very seldom used, and should not be necessary, but if desired it can be done by rolling up the cleaned and dried etching with etching ink, topping powder (blowing off the surplus powder), melting in the top as usual except that an extra heavy top is given and it is allowed to melt down the sides of the lines; after the shoulder has been removed in the etching tub, the plate is cleaned, blackened, and charcoaled as usual.

Half-tones on zinc are usually given only one good bite, without any four-ways powdering, but course screen work such as 60 or 65 lines to the inch, or even 85 lines, may be given one four-way powdering and an extra bite if handled carefully. In powdering a half-tone zinc plate, however, the etcher must use skill and discretion against rough or uneven powdering, or a rough smudgy half-tone will be the result.

If the plate contains half-tones or fine "Ben Day" tints, in combination with the line work, the half-tones or tints, etc., should be painted up solid with staging or etching ink after the first or second bite. This protects these parts, which are really finished, while the lines are being etched to their proper depth.

Zinc Graining.

Zinc Graining is one method of producing a tint on zinc, and is done entirely by the etcher. The method is used to some extent yet, although not so much as in the past, especially since the advent of the "Ben Day" process of laying tints and shades on the metal. The method of graining, however, will be very briefly explained for those desiring to know.—A large tall tight box stands upright, containing a small quantity of Dragon's Blood powder at the bottom. Also near the bottom is a small hole to admit the nozzle of a bellows, and a short distance above is a sliding rack on which the plate may be slid in and out. With a sudden blast of air from the bellows through the hole in the box, a cloud of the powder is raised to the top part and allowed to settle, filling the box with a very fine dust of powder which is so fine that it settles very slowly and evenly. After stirring the powder up well and allowing it to settle somewhat, the plate to be grained is slid into the box, face up, by means of the sliding rack, and the Dragon's Blood powder, in settling, covers the plate with a fine even grain. The plate is withdrawn from the box and burned in over the stove to melt

the powder onto the plate. If the grain does not seem to be dark or strong enough to produce the desired tint, the same operation can be repeated until it is satisfactory, laying one grain over the top of the other. When burned in we now have the plate covered with an even grain tint of acid-resisting Dragon's Blood, which can now be etched by the usual zinc method. If only certain parts of a design are to be grained, of course, the other parts of the plate (wherever no graining is wanted) must be painted over with gum gamboge, opaque, or other water-color pigment before the grain is laid, as in the "Ben Day" process. (See "Ben Day" Work.) Another form of graining box, preferred by many, is one which is hung at its centre in such a manner that it can be revolved rapidly. This box has no bellows opening as in the stationary type, as the powder is stirred up by swinging the whole box over rapidly several times, then allowing it to settle. The plate is slid in and completed in the same manner, as previously explained.

Re-Topping.

In using Enamel for Zinc Etching, it is sometime difficult to get good depth without the enamel resist lifting or breaking through in places, especially on line work where considerable depth is required. If the enamel is seen to be ready to break through, or looks uncertain, after a fair depth is reached, the plate can be rolled up with etching ink (using a hard composition roller and plenty of ink), powdered over well with Dragon's Blood or Topping Powder, the loose powder blown off clean, and the "top" burned in. This will give a new resist top composed of ink and powder as in the ink process, and further etching can be carried on with safety.

"Stop-out", or color zinc plates, are etched precisely the same as the ordinary zinc prints. The prints, of course, are "stopped-out", scratched, painted up, Ben Dayed, etc., as required in preparation for the etching.

COPPER ETCHING

The Printing of the image on the copper plate has been described under the heading of "Metal-Printing", so we can begin here with the print, developed, burned-in, etc., ready for etching. It is presumed, of course, that the back of the plate has been shellaced for its protection as usual, and also any defects on the print spotted up and burned in.

Copper Etching usually refers to half-tone work, but where line work is etched on copper, it is handled the same as on zinc. After the first bite or "flat etch", (excepting the difference in the etching solution used), powdering four ways wih Dragon's Blood powder, etc., until the proper depth is obtained. While Copper Half-tone etching is based on the same principal to some extent as zinc etching. i. e., the metal is etched or dissolved away by chemical action, yet the work is entirely different. In zinc etching the main object in view is "depth", while in copper etching we must work for "color" or "tone".

Clearing

The first difficulty usually encountered in copper half-tone etching after the print is obtained is "scum". This may be described briefly as a very thin film or haze of enamel adhering over the "open" dots of the print, and must be removed or "cleared" before starting the etch, or a ruined plate will be the result. Scum can generally be removed by any of the clearing solutions given in the list of formulas, such as the permanganate or salt and acid solutions, rubbing over the plate carefully with a small tuft of cotton, sometimes the aid of bicarbonate of soda in conjunction with the clearing solution being necessary. A very weak solution (not over 5 per cent) of potassium cyanide may be found satisfactory, but this must be used with discretion or the enamel print is likely to be weakened. Care must also be used with the

soda, as too severe rubbing is apt to grind the enamel thin and cause it to break through in etching. If the scum appears obstinate and does not yield readily to the clearing solution it is usually safest and best to polish off the print and repeat the operation. After the scum has been removed so that the copper shows bright and clean in the open dots, especially in the shadows. the plate is well rinsed and is now ready for the "flat etch".

Flat Etch.

The etching solution used for copper is Perchloride of Iron (or Iron Chloride), and should test by hydrometer between 35 and 40 Baume. The temperature of the solution should be satisfactory, or normal, in the average workroom, but if very cold its action is very slow. For very rapid action the solution can be heated up to as high as 100 deg. F. The most satisfactory method of etching, especially on fine screen work, is face downwards in a still bath of the iron solution. Nothing is gained in half-tone work by rocking the bath (as in zinc etching) if the plate is face downwards. On the other hand, if the plate is face upwards rocking will generally increase contrast somewhat, but the depth is greatly lessened. Again, still-etching face upwards produces a flat or gray effect, and is sometimes used in color work, but again loses in depth. Depth on half-tones, while sometimes looked upon as a secondary matter, must be considered important at least, as a half-tone with excellent color will often print up very unsatisfactorily on account of being shallow. However, if properly handled during the etching processes, it sholud have good printing qualities. So at present we will consider the first mentioned method, the one in general and most satisfactory use for clean soft printing results. The plate is suspended in the iron solution about ¼ inch from the bottom of the tray by means of two small blocks of wood placed on opposite sides of the plate, the edges of the plate being inserted in shallow grooves sawed in the blocks

about ¼ inch from the end. In starting the "flat etch", the plate, after being cleared of scum and well rinsed, is dipped face up into the iron solution and brushed lightly all over with the iron, using a broad soft camel hair brush or a good sized tuft of cotton, in order to insure an even start in the etching tray. The two blocks are now placed on the opposite edges in the manner just described, and the plate "slid" edgewise face down into the iron. Care must be taken to slide the plate smoothly into the solution, and not to merely lower it straight down flat. thus avoiding air bubbles on the etching surface. The time or duration of the "flat etch" is governed principally by the pitch, or coarseness, of screen used and by the character of the print. The shadow dots in particular must be judged, the smaller shadow dots permitting a longer etch than more open ones, not over-looking, however, that the middle tones must also be dark enough to stand the desired etch without losing color. It is desirable, as a rule, providing our negative is correct, to obtain a fairly strong print on the metal and allow for a correspondingly long flat etch, thus procuring good depth and clean printing qualities. As a general rule, for 133 screen (the most commonly used), the flat etch should not be less than 10 minutes with the iron solution at normal condition, and the time might be increased in some cases to 13 or even 15 minutes. Careful judgment should be used, however, before attempting 15 minutes for 133 screen. A fair average for 85 screen might be struck at about 18 or 20 minutes. Finer screens, likewise will require shorter etch, but the color or "strength" of the print is a great controlling factor in any case. It is also important to move the plate occasionally in the solution, so that fresh iron may reach the etching surface from time to time, thus etching cleaner, deeper, and smoother, and especially avoiding spots from any bubbles which might interfere with the chemical action.

When the time of flat etch has expired,

the plate is withdrawn from the solution, rinsed well under the tap, dried with the dampened chamois and then over the stove. A fine stiff cleaning brush is now used to "dry brush" the etched surface, brushing well in two or more directions and reaching all parts of the work. The reason for the brushing is this:—in the process of flat etching, the iron solution, besides etching depth, works slightly under the edges of enamel, leaving a very small over-hanging ledge of enamel, or "cap", around each dot. Thus the apparent dot is larger than the actual dot of metal or printing surface. Dry brushing breaks away these tiny caps, showing the dots (and consequently the tones) in their true values. After dry brushing, the plate is "chalked up" with magnesium carbonate (in cake or powdered form), rubbing the magnesia well into the etched dots and off the enamel surface quite clean with the fingers or palm of the hand. Care must be taken not to scratch the enamel by allowing any grit to be rubbed in with the magnesia. We now have an etched image on the copper plate, in half-tone, resembling fairly well in light and shade the original photograph or "copy", excepting that it will appear somewhat "flat" or lacking in brilliancy as compared with the copy, the high-lights especially appearing darker than the original.

Staging

The plate must now be judged for color, or tone, comparing it with the original copy. The shadows and darker tones should be found to match the copy quite well, and these parts must be protected or held from further etching while the rest of the work is lightened to correspond with the lighter tones of the copy. This is done by what is called "staging" and "crayoning". Staging is used on parts where the copy calls for hard sharp-cut edges of tone and where the tones are to be held just as they are on the flat etch. This is done by painting over those parts with "staging ink", using a good red sable or camel hair staging brush (a round, full well

pointed artists' brush, commonly known as a "rigger"), painting in solidly and smoothly all parts to be held absolutely protected from any etching action when the plate is again placed into the iron solution. Crayoning is used where small soft details are to be held, or where fluffy uneven masses are required to retain their color softly blended, or practically wherever tones are to be held to a greater or less extent, depending on the manipulation of the crayon, to retain the soft delicate blending of the copy. Carefully trained judgment and experience, however, are necessary to enable the workman to know how best to handle each subject, just where to stage, where to crayon, and just how best to handle the crayon on the different parts of the work in hand. (The crayon used is a black greasy lithographic crayon, in the form of paper-wound pencils or in heavy hexagonal sticks (paper covered), or a good grade china marking pencil (paper-wound) will be found practically the same article as the litho crayon or pencil. It is impossible to explain exact rules to govern all classes of work, as each individual subject must be judged and handled by the workman himself, keeping in mind in connection with the staging and crayoning, the manipulations following, such as the "short etch" and re-etching". Right here is the point that to a very marked degree classes a half-tone etcher as a good or poor grade of workman. However, a few general hints will serve as a guide.

In the average portrait work very little, if any, staging is used, crayoning usually taking care of the necessary tone protection. We can usually start by crayoning the eyebrows, drawing the litho pencil in a clean sweep from the end of the eyebrow nearest the nose toward the outer end. Enough pressure must be applied on the crayon to force it well into the open dots of the plate, thus giving the eyebrow tones strong protection from etching yet retaining their original hairy softness. Next, the lower edges

of the eyelids, from the nose outward in the same manner as the eyebrows except that finer lining must be used. A small hard dot of crayon will usually be found necessary in the corner of the eye directly against the nose, at the inner end of the lid line just crayoned. The entire iris (or colored portion) of the eye must be crayoned heavily and smoothly, working the pencil in a small circular motion. Occasionally, but not always, a slight touch of the crayon on the under part of the eye will improve color. The nose next demands attention, but very seldom any work will be necessary here except a small hard touch of crayon on each nostril, and occasionally a light touch around the outer curved portion of the nose on the shadow side of the face. In crayoning the mouth, only the under side of the upper lip is crayoned, usually, as well as definite indentations at both ends of the lips. Care must be taken, however, in crayoning the lips, holding their proper shape and expression, and the little indentations marking their ends are very important to hold expression. Very rarely, also, a slight touch under the chin to hold the suggestion of shadow is good, but here again good judgment must be the deciding factor, depending on the copy always. In crayoning the hair the workman must notice carefully the trend or general direction of the waves of the hair, also the lighting on it. Work the crayon in the same general direction, working in the shadows and darker portions, not attempting to strengthen any individual hairs, or even suggestions of such, but working more in masses of tone, light and shade. All spotty or patchy effects must be avoided, crayoning in broad full effects particularly in the lower or deeper curves of the hair masses, allowing the lighter tones, especially the highest lights, to remain freely exposed for more etching. Strong crayoning is usually more satisfactory on the hair than too weak, so there is little danger of over-crayoning. In case of a dark back-

ground, darker than the actual subject, the whole background can usually be staged in (with brush) at once, but if the background appears too dark in comparison with the copy it is left clear for slight further etching. A blended background may be treated by staging in the darker half and leaving the lighter free to etch, carefully blending where the dark and lighter tones of the background meet by smudging the staging ink here softly with the finger. A white background is commonly handled by painting in the whole figure after being wholly finished as to tones, (staging and re-etching, etc.), and taking the background down white separately. Smaller portraits, of course, require less working in detail than larger, and at all times the etcher must rely on his own good judgment for the result required. Groups are handled much the same as individual portraits, although usually less fine detail and working up is necessary, but separation of the individual figures should be strengthened where possible by holding a dark figure and lightening an adjacent lighter portion so as to slightly increase contrast and give an apparent "depth" and clearness to the group as a whole. Many of the darker shadows can be quickly and easily handled by simply painting up the darkest portions and smudging or blending with the finger toward the lighter tones, painting clean and sharp, of course, where the detail calls for such handling.

Landscapes and general views, while quite simple after a little practice on different classes of subjects, will be found slightly more puzzling at first on account of the varied effects calling for varied methods of handling. Practically every picture that represents an outdoor scene can be divided into two sections, or general details, i. e., foreground and distance, and usually also the space between the foreground and distance, termed "middle-distance", contains the most important object and the sharpest details in the entire picture. The eye is not capable of focusing a

distinct image of both foreground and distance at the same time, and therefore the principal features on which the eye adjusts its natural focus will appear more clear and distinct, the background or more distant details becoming more or less hazy or blurred. The foreground usually is more clear and distinct than the distance, being only slightly more blurred (generally) than the middle distance, so for convenience it will only be necessary here to consider foreground and distance. So far as the half-tone etcher is concerned, these terms are introduced here only because they have a decided bearing on the effect of a picture, producing atmosphere, strength and a certain natural attraction or "meaningness" that the etcher must strive to hold properly to do the work full justice. Briefly, for instance, let us first decide on the most important subject in the picture, or the chief feature the photographer or artist had in mind in making the original picture, which is very seldom in the "distance" except in strong cloud effects, sunset views, etc. We proceed to crayon or stage these parts where necessary, holding strong shadows, details, etc., working for tone and brilliancy in these principal parts especially, keeping the soft distant objects more in reserve and less detailed. Some subjects will require more crayoning while others more staging; some may have a good deal of both while yet others should have little of either. A great deal of time and work can be saved sometimes in working up foliage by simply painting same over roughly with staging ink, using the brush fairly dry. In this way, while the shadows take the ink quite readily the higher lights will take care of themselves quite well, the brush seeming to slide over the dots somewhat rather than stick and cover the greater amount of chalk (magnesium) between. As stated before, this class of work is quite varied, each subject must be handled in its own way according to the etcher, and time and experience alone (beside artistic talent) will enable the etcher

to judge well and quickly how best to handle each particular job.

The next class of subjects, and a very important one, which demands particular attention is catalog work, silverware, jewelry, machinery, etc. Here again the subjects are so varied and the different requirements are so numerous that the etcher must learn by practice and a great deal of study of different subjects and effects before he can feel anywhere near proficient. A good catalog illustration will often be a great step toward selling an article, while a poor illustration even of a good article might be a hindrance to its sale. So it is easily seen how important the subject is, and the etcher must strive to retain so far as possible all the delicate tones, brilliancy, softness, sharp reflections, or other essential characteristics of the original copy. The majority of half-tone etchings of this class of work are made from "re-touched photos", that is, from photographs that have been worked up by an artist, using air-brush, lamp black and retouching white, photograys, etc., and often from the amount of hand work becomes very valuable and represent the article pictured in its highest degree of perfection and pictorial beauty. It stands to reason, then, that unless the etcher does justice in reproducing it on copper to compare very favorably with the artist's re-touched (or worked-up) photo or drawing, the whole work and care up to this point has been practically for naught. If the subject in hand is a piece of silverware, the soft blended shadows and the bright spots of reflection must be watched carefully, bringing out the strong high-lights sharply whenever called for. Care must be taken also not to lose the detail or distinct pattern, which distinguishes it from other designs. The proper "texture" or "surface" must be truly represented, a "satin-finish" being shown as a satin-finish, not as a "bright" polished finish. Cut glass ware must retain its marked brilliant "glint", and this can usually best be

done by holding some of the deepest shadows or cuts solid black (or as nearly black as possible) while the highest lights or brightest reflections can be etched almost until the tiny speck of enamel on the dot are about to be lost,—(by re-etching). Furniture, as a rule, will be found comparatively easy, care being taken not to lose the grain or finish, and to hold the proper shadow side and proper tones on all parts. Caskets will usually be found quite difficult, both in the operating and the etching. It is usually best to stage in the whole black body at once after the flat-etch, handling bright nickle handles, etc., independently according to requirements. Silk lining can be crayoned if the crayoning is done carefully, handling it lightly and heavily as required to bring out the deep ruffled silk effect. Its light fluffy appearance must be held well, avoiding all tendency of heaviness or harshness. Yet, the detail must not be killed or softened in such a way as to look like velvet or other material instead of silk. In handling machinery, stoves, etc., the natural dark tones of the iron must be held well according to the copy. Usually one can start by crayoning in a few of the strongest shadows which lend themselves to the curves, projections, and other irregularities of the iron parts, ready for a short etch in the iron bath, taking care also, of course, of the crayoning and staging necessary on the nickel parts at the same time. Often a second staging and second short etch are required on machinery, and in this class of work, if in any, the operator must do his part by producing a good negative in order to give the etcher any sort of a fair chance. Machinery is usually difficult enough and requires considerable hand work, although an experienced etcher should know just about how best to handle the job at a glance.

Short Etch

After the crayoning and staging has been completed satisfactorily, it is burned in over

the stove until a wet finger touched to the back causes sizzling, as in burning in "spotting" or "touching up" on the print before etching. When the plate is cool, the magnesia is cleaned out with a weak acid solution, or "chalk remover", preparatory to a "short etch". This solution merely dissolves the chalk, leaving a bright copper surface between the enamel dots, thus allowing free even action of the iron solution in the short etch. The chalk is best r-e moved by first wetting the plate under the tap and then flowing over it some of the acid solution, rubbing it over with the fingers or palm of hand, thereby not injuring the tiny dots in any way. A fine cleaning brush may be used if not too severely. When the chalk is all dissolved and the copper again looks bright and clean, the plate is dipped into the iron solution so as to insure even covering, placed into the two blocks as before, and again slid edgewise into the etching bath face down as in flat-etching. This time, however, the duration of etching must be short (short-etch), as on it depend a great deal the smoothness and natural gradation of tone in the details or middle-tones of the finished job. Just as in flat-etch, of course, a coarse screen will require a longer etch than a fine screen to produce the same tone values. As a guide to the time of short-etch, an average of 1-½ minutes may be used for 133 screen, or between one and two minutes usually, depending on requirements of the particular job in hand. Anything over two minutes is very apt to show too harsh gradation or steps of tone and show crayoning up too strongly. There are exceptions, of course. For 85 screen about 3 minutes might be struck as a fair average. While this short etch acts on the high-light dots as well as the middle tones, the highlights need not be taken into consideration just at present. If the negative from which the print was made is good, the highlights will be plenty large enough to stand the short-etch and still require more lightening later (re-etch). For the time of short etch or any certain screen one must judge especially

the middle-tones to determine the time according to the amount of lightening of tone required. This soon comes with careful study and experience.

Re-etching

When the time of short-etch has expired, the plate is removed from the bath, well rinsed, dried with chamois, warmed slightly and powdered again with magnesia, and judged for color in comparison with the copy. The parts that had been staged in will, of course, remain covered, allowing no action of the iron solution on them; the middle tones will to a great extent compare favorably in tone with the copy, but while these will likely require some working up in tone here and there, the high-lights particularly will require to be lightened up and blended by hand. This part of the process is called "re-etching", or sometimes "fine-etching", and consists of lightening tones locally by hand, using perchloride of iron solution (same as the etching bath) and a stiff bristle or Chinese marking brush. The iron is brushed over the parts to be lightened, allowed to act on the copper a moment slowly etching the dots smaller in size and greater in depth, then swabbed off with a large tuft or ball of quite moist absorbent cotton. More iron is again laid on with the brush, allowed to act somewhat, and is again swabbed off with the cotton. The Chinese re-etching brush is held in the right hand and the cotton in the left, and used alternately until the dots over the various parts of the plate are reduced to the desired sizes. The first application of iron dissolves the magnesia out of the dots, thus making it impossible to judge the plate now by general color or tone as before. The etcher must therefore learn to judge different tones by the different sizes of dots in those parts of the plate, also remembering, of course, that these sizes will vary in the different screens to give the same value or finished tone.

Just as in staging and crayoning, no solid rule can be laid down for re-etching, but the workman must learn to depend on his own

judgment and skill to know just where and how much to re-etch. A brief guide may be helpful, of course, always following the color and blended harmony of tone in the copy as closely as possible. In re-etching a portrait we can usually look for a strong narrow line of high-light down the front edge of the nose, and this can usally be lightened to considerable degree by re-etching, being careful, however, to hold the line narrow and sharp according to the copy. Hold the re-etching brush fairly perpendicular and draw the tip only along the high-light of the nose, allowing the iron solution to act somewhat before touching it with the wet cotton. After the plate has become wet in this portion the next application of the iron chloride will have a tendency to spread and blend rather than hold the high-light sharp and clear. As the application of iron begins to spread, the wet cotton must be brought into play at once, dabbing the etching solution off the metal and applying the tip of the brush again in a fine line, thus eliminating spreading and broadening of the high-light. The forehead and cheeks, especially on the lighter side, must nearly always be re-etched somewhat, but here the lights must be blended very softly (following copy) instead of being held hard and sharp. The chin, also, usually requires a small blended spot of high-light, though this is sometimes kept more subdued than the cheek. The hair may require considerable toning up in the higher lights, rounding out the waves and curls, etc., in natural masses of light and shade, bringing the tones in all cases as near as possible to those in the copy. A white collar must usually be lightened considerably, in many cases the highest lights becoming merely pin-point dots. No matter how fine the dots are, however, care should be taken not to lose the tiny speck of enamel on each dot. A pin-point dot generally refers to a dot brought to the smallest size possible without losing the enamel. If the enamel is seen to break away from its support from

being too fine to hold or from too much brushing the re-etching must cease at once, as the printing surface of a small dot without enamel will enlarge on re-etching instead of decrease in size. The workman must train his eye and judgment to see quickly and at all times the shade of tone, softness of blending, and general natural effect of the copy and train his skill to bring his etched plate to favorable comparison with the copy. High-lights on white drapery can also often be reduced to pin-points where the copy calls for pure clean whites. The detail in any case, however, must be held well, and in this point the work is apt to fail to some extent unless carefully watched and skillfully avoided. White backgrounds will very often require dots, almost pin-points, but unless properly etched, very fine points are difficult to print cleanly upon the average grade of book-stock, so unless the dots permit of good depth and are properly handled it is sometimes better to leave them very slightly larger than the copy apparently calls for. This again depends on the skill of the etcher. Landscapes and general views must be handled each according to its own individual case. Where a copy calls for a white sky, that portion of the plate must be brought down quite fine, any cloud effects, of course, being held where required. Lakes, ponds, or other small bodies of water can usually be hanlled much like the sky, crayoning in such shadows and reflections as necessary, but are seldom as white as the sky. These small mirrored surfaces really borrow their color or tone reflected from the sky, so it is evident that there will be some resemblance of tone at least. However, some of this sky hue is absorbed by the depth of the water, hence the water is usually slightly darker. A small point of this kind might at first seem insignificant, yet such little facts in nature have a decided bearing on the whole subject. Silverware, etc., must also be handled with careful judgment of the copy, re-etching the high-lights sharply cut or softly

blended in keeping with the subject at all times. Remember, however, that high-light dots usually increase slightly in size when printed onto the paper, so that where the copy calls for strong whites, care must be taken to see that they are quite fine on the etched plate, in fact slightly exaggerated if anything. Sometimes rough machine parts or castings which show no true high-light, but merely a lightened side produced by its rounded shape, can be handled best by painting the whole article in after the flat-etch and then re-etch what is necessary after cleaning off the whole plate of its staging.

Vignettes

If the copy contains a soft vignetted shadow, the extreme light edge or boundary of the vignette (vin-yet') is painted around with the staging brush after the flat-etch, simply drawing a line about the width of the brush, paying no attention to the outer margin of the brush-line, but marking fairly distinctly the inner margin, or the extreme edge and shape of the vignette. This is burned in along with the staging and crayoning, and when the work is ready for re-etching, the vignette is re-etched down carefully, blending well and procuring especially deep and sharp clean dots at the edges. In some special cases where a very long or large blended vignette is required, it is a good plan to rest that end of the plate (after otherwise finished and painted up for protection) into the iron solution, face up, and gently wash or paddle the iron over the vignetted edges with the hand or a broad brush. This method works clean and fast where it can be used, but great care must be taken not to carry the work too far and experience and constant watching are necessary.

Cleaning Plate

After the etching has all been satisfactorily completed, chalking up the plate again during re-etching if necessary to watch the

progress of the work, it is now ready for cleaning up. Any chalk or iron stains remaining on the etched plate can be cleaned off with the acetic or hydrochloric acid chalk-removing solution, rubbing gently in with a little bicarbonate of soda if necessary, and then dried with the chamois. If there are no bad stains present, the plate can immediately be warmed well over the stove, and scrubbed over with gasoline to remove all staging ink and crayoning, using a stiff brush for the purpose. The brush must be fine enough, of course, and fairly clean so as not to scratch the enamel surface or delicate dots of the plate. A better solution to use for this cleaning purpose is a mixture of benzole (or gasoline), alcohol and turpentine, about equal parts. This will usually clean the crayoning and staging from a well warmed plate if anything will. After cleaning, the plate is again chalked up with magnesia to pass along to the "finisher".

The question has been asked, "Why should not the high-lights in the negative be small pin-point dots, or holes, as in a negative for "offset" work? The reason is this: the high-light dots in a half-tone plate must be deeper than any other part of the plate, especially deeper than obtained by the "flat-etch", because being small they have greater distance between them which would allow the paper to sink in and smudge in printing if they were shallow. The large size of the high-lights on the negative or print allows for this extra depth being gained while they are being brought down to proper finished size by re-etching.

In any case, the quality of high grade etching that particular customers demand from fine copy depends greatly on the artistic skill of the etcher and his ability to adapt himself to the occasion. He must take pride in his work and a critical liking for the results produced. And while the foregoing treatise might seem long and tedious and time-wasting, it is surprising how well and

quickly a thoroughly trained and experienced workman can produce the desired results, which should be both pleasing and profitable. At the same time, it is not contended here that all subjects at all times require or demand the care and amount of work laid out above. In some cases the work is deemed more or less of second grade, and in some the price quoted would not well permit it. But it is easier for a good etcher to swing to an occasional rush cheap job than for a poor workman to turn out a fine job that will please the most critical customer.

Machine Etching

In this age of "speed", when service and production are necessary to keep pace with the times, many of the largest and best equipped plants use Etching Machines. Most of the etching machines on the market and in general use throughout the country are very satisfactory for their purpose, and do the work much more quickly than above described pertaining to the actual etching process itself. This is especially true in regard to zinc etching, yet for some classes of copper etching, both line and half-tone, a suitable machine is a worthy asset.

A very popular machine in use in many countries is the Levy Acid Blast. This is especially good for fast clean and deep zinc etching. Its working principal is a mixture of acid vapor and air is forced through numerous small nozzles at the bottom of the machine or tank, spraying upward against the inverted zinc plate. The unprotected parts of the print, of course, facing downward and receiving the full force of the acid spray, are etched away. The machine works smooth and clean, giving slightly tapered lines (if properly powdered, in relief for printing. This machine simply takes the place of the rocking tub, doing the work faster, usually cleaner and with less tendency of under-cutting, and less fumes entering the workroom. The four-way powdering, of course, has to be used on each

bite just as in tub etching; this can also be well done by a machine, (Levy), if desired. A guide to etching time for line zinc with the Levy Acid Blast machine is:

1st bite—30 to 40 sec.—air press. ½ to ¾ lb.
2nd bite—1 to 1½ min.—air press. 1 lb.
3rd bite, etc.—4 to 5 min.—air press. 1 lb.

Another excellent machine, which has found great favor, is the Axel Holmstrom Etching Machine. This is quite suitable for either zinc or copper (the author has used it for both), and works on a principle of a paddle wheel, forcing a broken spray of acid solution against the plate, which is inclined against one side of the tank. The time for line zinc will usually range from about ½ minute for the first bite to 4 or 5 minutes for the third or later bites, in all cases of course depending on the strength of acid, nature of the work, and the workman's general way of handling. For copper half-tones, of ordinary fine screen (133), the "flat-etch" will require from 2 to 2½ minutes, reversing the plate end for end at the expiration of half the full time. Other screens timed in proportion.

A third machine of merit is the Holt Etching Machine, especially suitable for copper half-tone work where a machine is desired. In this machine, the copper prints, or plates, are laid on a table in the bottom of the tank of the machine, face up, and on lowering the table (and plates) into the etching solution, the lid closes and a disc automatically starts to revolve in a horizontal motion over the plates. On the under side of the disc are blades set at suitable angles to swirl the solution downward against the plates.

Another good machine, the "Century", works on a principle of a dasher on which the plate is fastened face down. Here the plate is dashed or plunged against the surface of the etching solution by means of an electric motor, the solution forcibly impinging upon all exposed surface of the plate.

Still another, a "process" rather than a machine, is the Weeks Electrical Etching Process. This is used on copper halftone work, and the plate is "etched" by means of electrical action, or more definitely, by what is known as electrolysis.

All these machines are protected by patents.

"He touced the brow—the lip—it seemed
His pencil had some magic power"

—Wilson.

COLOR ETCHING

Three-color Theory

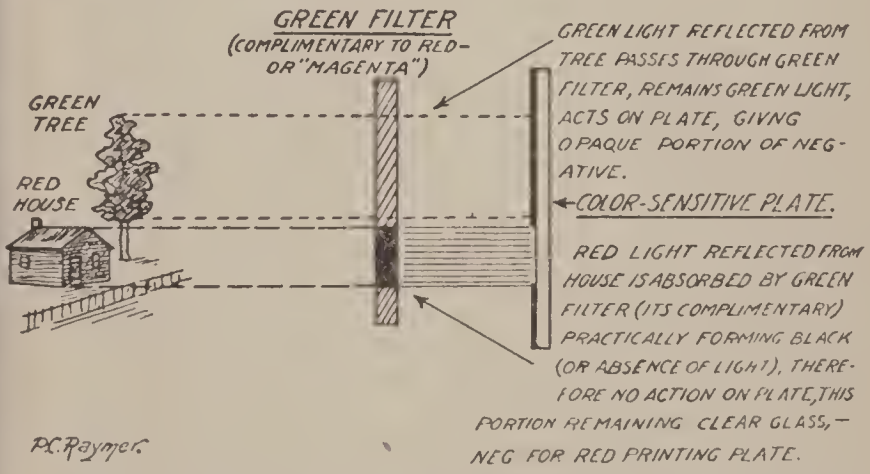
Three-color process work is based on the principle that all colors found in nature are represented by three primary colors mixed in suitable proportion. Just as the artist can, if he chooses, make a beautiful painting in innumerable colors and shades, using only three properly chosen colored pigments, so can the color printer produce a wonderful duplicate of same by printing three properly-made plates in three properly-selected colored inks. He has the advantage, also, of producing as many duplicates as are desired, whether one or thousands.

Color, in the very beginning, can be divided into two great groups, i. e., "light" colors, known as "plus" colors) and "pigment" colors (known as "minus" colors) and found in printing inks, paints, and other coloring matters. Each of these groups can again be broken up into three divisions, known as "primaries". When we break up a ray of pure white light, by means of a prism or a scientific instrument called a spectroscope, we find (with sufficient knowledge of science) that while seven distinct color bands are visible only three primary rays blend to form those different colors, namely: red (bright orange-red), green and violet. These are the "plus" primaries, such as compose white light, and the method of mixing is called the "additive" method, adding one color to another. Now, suppose we look at a piece of so-called pure "white" paper. What actually happens here is: that particulr paper has the power of reflecting all rays of the light thrown upon it back to our eye. Consequently, since all "light" rays blend when combined naturally forming "white", we call the paper "white". Now, let us print an impression of so-called pure "yellow" ink onto the paper. The ink used has the power to absorb, or "subtract", a certain col-

ored ray of the white light, which is really complimentary to the color of the ink used (in this case the violet). The so-called pure "primary red pigment" (more correctly "magenta") printed onto white paper absorbs the green light (its complimentary) and the pure "primary blue pigment", which is practically a strong cyan or peacock blue, absorbs the bright orange-red light (its complimentary). The three "minus" primaries, when mixed by printing one over the other, form black (absorbing all light rays). This method of mixing the pigment colors is called the "subtractive" method. The third method of pigment color mixing might also be mentioned here: the "juxtaposit" method, in which small particles of different colors are placed very closely adjacent. An excellent practical example of this method is the Lumiere Autochrom plate, while a very simple and common example might be found in a distant wooded landscape in autumn. In the latter, the subject in view is really composed of innumerable vary-colored leaves, bright yellows, reds, a few greens, browns, etc., while at a great distance the optical nerves become so confused that all colors appear to blend into a fairly even hue. So, in short, careful scientific research has proven that the "plus" (light) colors and the "minus" (pigment) colors are very closely related and dependent on each other, and in studying them we must not get the two terms confused. However, the color etcher need only deal with the minus or pigment colors, but he must acquire a thorough knowledge of those. Yet, a slight knowledge of the "separation" of the minus primaries for his work will not come amiss.

The artist's painting, then, or any other object that is to be reproduced, has gained its colors by the use of only three pigment primaries, yellow, red (or magenta) and blue. For the three printing plates, then, these three colors must be separated, or "unmixed" as it were, one color for each plate, so that when the finished plates are again superimposed on

paper in the printing press in the same pigment primary colors as were "unmixed" in the negatives, the primaries will again be mixed in the same proportions as they were on the corresponding parts of the original painting or object. This color separation is done in the camera by photographing through color filters, each filter being a suitable transparent stained glass of a color complimentary to the color to be separated (or "unmixed") from the painting. The negatives must, of course, be rendered in Half-tone for Copper Etching. Here also, as in reference to the half-tone negatives in the Introduction, details of operation must be omitted. The accompanying diagram will suffice in a very simple form, to give the reader a clear conception of the general idea.



The color half-tone negatives must not be made at the same screen angle, or the regular dots of the successively printed plates would simply cover those of the previous plates, destroying the color effect. Therefore, each negative must be made on a different screen angle. When two or more half-tone screens are superimposed at very small angles an unpleasant regular pattern is produced. To avoid this, the stronger colors are kept at as great angle apart as possible. The following angles are found to give good results. The final mixing of the colors in printing, then, is by a combination of the subtractive and juxtaposit methods.

3-Color Angles

4-Color Angles

ETCHING

Color etching is done practically on the same order, so far as the general manipulation is concerned, as ordinary black-and-white copper half-tone. The great difference between the two is the fine conception and knowledge of color required. For this purpose the etcher must train his eye and mind carefully to be able to judge and compare colors, shades, tints, strengths of tone values, etc., as well as detail, softness, and atmosphere in a picture, and also have a thorough knowledge of the mixing of the three pigment primary colors. For convenience and simplicity, we will call the magenta pigment simply "red", as it is commonly called, the pigment primaries, then, being yellow, red and blue, of absolute purity. To this end, a good etcher's color chart may be found helpful, by which colors can be matched to some approximate degree and the dot formation in each primary studied, the etcher allowing for slight differences in his plates compared with the chart where necessary to produce the desired difference in the final printed color. A good knowledge of black-and-white half-tone etching is very necessary, of course.

A few remarks here, however, will be required. Color negatives are not stripped and reversed as other negatives, on account of liability in so doing of being distorted and stretched more or less so that the plates would not fit, or "register", in printing. They are reversed into the proper direction in the making, and also the operator usually flows them

with a gum "wet plate varnish" (when wet plates are used) so that no rubber and stripping collodion is required to protect the delicate surface. The printing is done on copper by the enamel process as in the black and white work, care being taken to get uniform prints on all colors and a properly timed flat-etch on each. If process dry plates are used, for the screen negatives, no coating is necessary, and the general handling is the same, except that a slightly thinner coat of enamel is advisable and over-printing must be avoided. If the negatives (either wet plate or dry) were properly made, the shadow dots in the red printing plate will usually be larger or more open than in the other two. This has a tendency toward softnes, and the proofs will show up less harsh and hard than if the shadow colors were strong in all plates. In fact, the etcher must avoid too much red in the entire job, as the red (magenta) ink is apt to print up stronger than at first estimated by the novice color-worker. The yellow plate is usually the heaviest and most lacking in detail; the blue usually shows most detail. Before being able to acquire by experience the knowledge of just how each plate will print up in its respective color, the etcher must have a keen mental conception of the exact hue and strength of his process inks. The printed results can sometimes be remedied, of course, by slightly changing the inks (such as, a heavy red plate can be compensated for in color by printing in a weaker red pigment, etc.), but this is bad practice. Learn the standard strength of color used, and etch the plate accordingly. To reproduce the copy faithfully and cleanly, it is often necessary to eliminate entirely certain primaries from some portions. For instance, in pure clean light greens the red must be eliminated entirely; in pure purples the yellow, etc. This is done by cutting away those portions from that particular plate (by the "finisher"), and the etcher usually marks those parts by scratching or otherwise. In some classes of work, such as landscapes, etc., the distant horizon will be too

heavy and strong in detail. This can be softened by "running through" with a "lining tool" to match the screen used; handled by the "finisher," or preferably by the etcher himself (see "Finishing"). By this method those parts are lightened and softened, at the same time breaking up detail and giving more "atmosphere" to the picture.

The foundation color process is the three-color, using 3 plates and printing in 3 full-strength primaries. The best permanent printing inks obtainable, however, are not perfect in their reflection or absorption, so a darker blue must be used to get strength in the shadows. The 4-color process, using 4 plates and printing in 4 colors, yellow, red (magenta), blue and black, is based on the 3-color, gaining more delicate softness and ease in rendering by using a much lighter blue (peacock or cyan) and strengthening the shadows and details by the aid of the black. The black plate must be very light in tone, or "grayed-down", or the whole job will be unpleasingly heavy and the color "killed". Sometimes, however, the fourth printing is run in neutral gray; in that case, the "black" plate will be heavier, much like an ordinary black and white half-tone. There is one advantage in using the black instead of gray in printing; that is, type matter, etc., can be run in black along with the black fourth printing color, thereby saving an extra press run. Duotones, or two-color half-tones, are affiliated with these processes, although they are usually made from black and white drawings or photos, and the colors "faked" in the etching. They can be run in any colors desired, but are generally etched for black and one of the secondary colors, or two suitable complimentary colors. Their screen angles are generally 60 degrees and 120 degrees. The negative for the key plate should usually be fairly high, and that for the tint more flat with plenty of color (medium flash, long straight, and little or no high-light exposures).

The "Duotone" example in the Appendix

was "faked" from a black and white photo (entirely, including photo, by the author), on 150 screen. The 3-color example is on 166 screen, and the 4-color on 150 screen, both from opaque water-color drawings and color-separation negatives. The 3-color Chart is on 133 screen. In using this chart, the large rectangular color patch is chosen which best represents the color to be reproduced by the printing plates. To the left of this patch will be found smaller square patches of the primaries in their proper dot strengths, of which the larger patch is composed. Each primary square should be examined under a linen tester and the dots matched in the etching of the corresponding plate. Any slight difference in color required, according to the copy, can be rectified by the etcher, by merely leaving more or less color in the proper plate or plates.

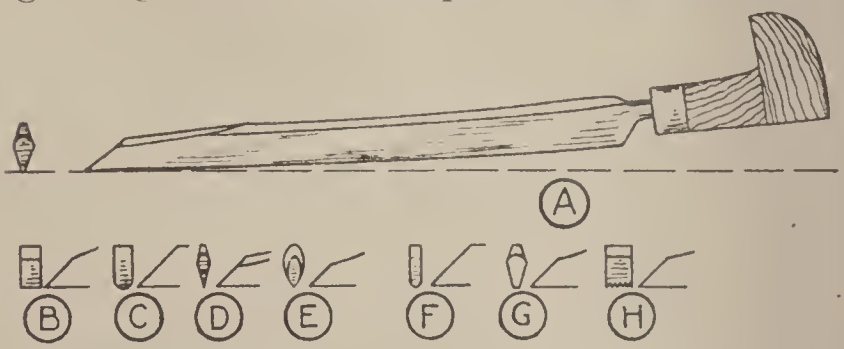
Art is natural—not manufactured;
Yet many natural resources are still undiscovered.

FINISHING

Finishing is the branch of photo-engraving dealing with hand tool work in general. It is closely associated with and aided by "machine work", but the latter will be introduced only for necessary explanation.

Outlining

The first step, and a very important one, is to learn well the tools and their uses. Few tools are really necessary if the finisher is a real "finisher", although numerous others may be added for special purposes, according to the workman's liking. A "finisher's pad" is, of course, essential, on which to rest the plate while tooling it. Illustration "A" shows an "outliner" (or angle tint), one of the principal tools used and perhaps the most important regarding choice of shape. It should be of



comfortable length to fit the hand, not too long, with a fair sized handle. The bottom edge is slightly curved, enabling it to be used over a large flat plate without the heel, or the handle, interfering; the edge proper should not be a "knife edge", but of sufficient width (rounded or flat edge) to cut a fair clean line without raising a "burr" on the curves; the point should be ground at an angle of about 45 deg. and touched up carefully on a hard oil stone, testing for sharpness by catching point in the finger nail. About a No. 6 (Muller's make) or a No. 8 (Murphy's) is very well

adapted for the purpose. It is used principally for "outlining" or cutting a line around ovals, machinery, jewelry and silverware, etc., and other "cut-away-background" work. Its method of use is as follows: Suppose we have a copper half-tone portrait (or any other subject) requiring to be cut down to an oval shape. First, the oval must be "outlined". If the negative has been trimmed to size and shape before printing, we have merely to follow th oval etched on the plate; if not, the oval shape must be marked in position by scratching around a "cut-out" form with a "scratch-point". This scratched line is then used as a guide for outlining. The proper method of holding the outliner is shown herewith.

On picking up the tool from the bench or table, the handle is first grasped into the fleshy part of the right palm, holding it tightly in position with the last two fingers, the end of the little finger placed against the corner of the large ball of the handle and the next finger tipped against the ferrule. The other two fingers are placed close together along the right side of the tool proper, and the thumb extended along the left side forward of all the fingers. The thumb is the principal guide for the point, and on it rests a good share of the responsibility. The tool must not be "enclosed" in the hand, but held only by the tips of the four fingers and the inner side of the thumb, so that the tool, fingers and thumb may be slid over a flat plate with all practically touching the surface. At first this grasp of the tool might feel very awkward and tiresome, but in time it will become as loose and

natural as picking up and using a pencil.

Now, the point of the tool is placed against the scratched oval line for outlining, the hand raised bringing the tool to about 30 degrees with the plate, and just a slight pressure given to insert the point barely under the surface of the metal. The hand is then lowered until it rests on the plate, and the fore part of the tool is practically parallel with the plate and only slightly below its surface. The back part will now be just off the metal so that it will not rub or scratch. Now with a steady and careful movement of the hand the tool is pushed forward, being careful to maintain the proper depth to keep it running smoothly in place. By lowering the handle slightly too much the point is raised and forced out, perhaps sliding directly across the work and ruining it. By raising the handle the tool is forced downward into the metal too deeply, causing difficult cutting and possible slipping out on account of too great uncontrolled force being applied. So, practice is the only method whereby the finisher can gain self-confidence and feel safe. When one has once mastered the tool in outlining, other tools and uses will be found more simple. In cutting straight lines, the plate is held steady by the left hand and the tool (in the right hand) is simply pushed sraight forward, following the line to the proper depth, but in outlining an oval, or any other curve, the tool point is held more or less steady and the plate is swung, or pivoted, on the finisher's pad. The plate is swung in the direction of the hands of a clock, tooling on the far side of the oval, thus keeping the axis or centre of that part of the curve always toward the workman. There are occasions, of course, when working on the near side of the oval is handiest, such as in very large work, but when one becomes accustomed to the other method, keeping in mind his own body as being the axis or centre of the "swing", he will find an advancement in both speed and accuracy. Of course, the tool must be pushed ahead slightly as well as the

plate being swung, according to the curve, the larger the arc the more the tool must travel ahead and the less the plate must swing. On very small arcs or circles sometimes the swinging of the plate is the only motion required. At the same time, in swinging the arc, the tool must be inclined, or "canted", toward the workman; in the same manner as a bicycle or race-horse leans toward the centre when rounding a curve. The sharper the curve the more the tool should be inclined, thus giving a smooth-cut line in all cases. In outlining machinery, jewelry, etc., where curves may run in one direction and then swerve into another direction, that is, the outline of the object may be partly bulged or "convex", and partly indented or "concave", one part of the curve is swung (as directed) and then the plate turned round to bring the next part of the curve into proper position for cutting, each sweep being cut as a separate curve and neatly joined at their meeting point. When two lines meet in an angle (what might be called an "internal angle"), such as is often found in furniture outlining, care must be taken not to let the back edge of the tool mar the corner by dragging or pressing into it on starting the line. This can be avoided by immediately starting the tool ahead as it is being lowered into the metal, doing away with all "prying" action at the corner; or sometimes both lines can be finished at the corner instead of starting there. In the latter case, at the immediate end of the line the point must be lifted straight up so as to snap off the little burr or shaving which the tool ploughs up ahead of it. If this is neglected, each corner will have a tiny point of metal rising from it, giving the effect in printing of a black dot centering a very small white circle instead of a clean square corner.

The Router.

After the outlining is completed, the plate is passed on to the machine room to be "routed." The "router" is a machine which

cuts away the background or the metal that is not wanted on the plate, by means of a cutter or bit revolving in a vertical position at great speed (about 14,000 R. P. M.). This removes the surplus metal, leaving (besides the actual outlined job itself) only a thin irregular line of metal outside the outlining, and a flange all round about ⅛ inch wide and ¼ the thickness of the plate, which flange facilitates nailing the "cut" onto its base block later. The router is also used extensively on line etchings to remove the surplus zinc.

Trimming Up.

Illustration "B" shows a flat bottomed tool, or "chisel." After the plate is routed, the finisher trims off the irregular line left by the machine, leaving a clean smooth edge to the whole half-tone design. For this purpose the chisel is mostly used, especially on all straight edges and convex curves (such as around ovals). This tool may be simply pushed sraight ahead, if there is not too thick metal to cut away, or in case of a heavy tough cut it may be used with a sort of "draw-cut" or scythe motion, starting the stroke with the lower corner of the tool (held edgewise) and drawing the tool downward as it moves ahead. In this manner, of course, only short consecutive strokes may be taken, but fairly heavy work can be done with speed and ease. Under no circumstances should the chisel have a twisting or prying action, or a corner is almost sure to be broken off. On concave curves, especially small ones, as often found on machinery cuts, the round bottomed tool, or gouge, should be used (illustration "C"). This tool will not scrape the edge in following around as the chisel would. It is also used for jabbing or digging out corners and small places too small to be routed out. The gouge can be twisted considerably without danger. In fact, many long, narrow spaces can first be rough-cut by using the gouge with a twisting or wiggling motion, then smoothed up with a steady straight sweep of the same tool.

Spotting.

Where breaks, slugs, etc., are allowed to enter into half-tone work, these defects must be corrected or "spotted" by tooling. Illustration "D" shows a "knife-edge" tool, same style as the outliner except finer, which is used for "running through" high-lights and middle-tones where solid spots occur in these portions. For instance, suppose we have a solid spot in a sky or other high-light. The knife edge tool (usually a No. 1 or 2) can be used to break up the spot into new dots by continuing the lines between the regular rows, running through one way, and then crossing at right angles, following the screen angle in each direction. The space must be cut wide enough to trim the dots down to correspond in size with those around them. To do this it might be necessary (except on the very fine screen) to use a coarser tool (about midway between the knife edge and outliner): or the desired effect can be produced by running through each way twice with the fine tool, once canting it toward the left and then to the right, thus cutting down the dots on four sides. The pressure or depth of cut also helps control the size of dots. A very smooth effect can be gained, especially in the coarser screens, by cross-lining as explained above, then cutting through again very lightly with a fine tool in two directions at 45 degrees to the screen angle, or ordinarily parallel with the sides of the plate. This simply cuts off the tiny corners of the dots, making them more nearly round and less noticeable; but it should not be attempted unless done with skill and care, or it is apt to look worse instead of better. Sometimes bad spots can be entirely obliterated in this way. The middle-tones can generally be handled the same way as high-lights, with a fine tool, but much less pressure must be used on the tool and very carefully judged in order to match the tone. The lighter middle-tones can generally be run through lightly both ways, while the darker middle-tones will often stand only one way, and then

very lightly. If very dark, they must be treated as shadows, only opening up more to match the surrouding tones. For spotting shadows a tool like "E" should be used. This has an elliptical point, is fairly short and stubby so it can be held quite perpendicular with the point sharp but not too slimly tapered. For fine shadow dots just a slight touch with the point, holding the tool upright, and at the same time giving it a very slight twist, will duplicate almost any small round shadow dot or hole.

Sometimes a scratched half-tone can be repaired quite easily while other times it is next to impossible. The metal is pricked up by raising a series of tall burrs in the path of the scratch, one directly behind the other, and the spaces well filled by rubbing soft solder wire into them. Then with a "burnisher" or flat "scraper" the solder and burrs are rubbed down solid and level with the surrounding surface. If necessary, the scraper may be used to cut or shape off the surplus metal. When the scratch is filled up solid, all that remains to be done is running through or picking shadow dots as required to match the screen, as in ordinary spotting.

Various Tools and Uses.

Figure "F" shows a small gouge very useful in trimming up in small places in conjunction with figure "C". Figure "G" is a coarse outliner, handy either for gouging out narrow places or outlining zinc (a coarser tool works better on zinc than a fine). Figure "H" is a lining-tool, and is quite distinct from the outliner. This is a sort of multiple tool, or a tool grooved along its bottom edge so as to cut a number of regular lines at one time, each tool made to match a standard screen ruling. The coarser tools (85 to 120 lines per inch) are often used in lightening or breaking up "Ben Day" stipple and grain tints, but the finer rulings are used mainly in breaking up detail, etc., in half-tone work (especially color-work). In color-work, the finisher, or etcher himself, uses a lining tool

which matches his particular job to run through heavy shadows in certain plates, to break up harsh or strong detail, sometimes to smooth up a roughly-broken screen effect. The method of use, in this work, is not to push the tool forward, but to track it in the screen ruling and draw it **backwards** through the defective part. In all cases, in running through, spotting, or wherever "tone" is the point in view, the plate should be kept chalked up with magnesia to follow progress of the work. Also, the linen tester should be used freely. For some work, such as fine outlining, color-finishing, etc., a large finisher's glass on a stand will be found very useful. This should be about 2 in. or more in diameter, and not too short focus, so that the field of view is large and there is plenty of space to use the tools between the glass and the work. In color-finishing, care must be taken to cut true and exact, leaving just a hair-line margin on each cut color to allow for register in printing.

"Square Finish" Half-tones.

"Square finish" is the simplest form of trimming half-tones, and is done by a "beveling" machine. This machine trims up the straight edges of the plate, forming also a beveled flange for subsequent nailing onto the mounting block. These edges might be simply trued up with a plain straight finish, or they might have a narrow black border line. For the latter the negative should have been squared to size before stripping, then it is only necessary to adjust the plate in the beveler so as to cut slightly outside the etched half-tone. The black border line, however, is generally accompanied by a fine white line cut immediately inside of it. The white line may be done with a "draw tool" before flat-etching, or on the beveler if the machine has a graved-line attachment. In using the latter attachment, the white line on each side is not cut quite to the corner; these unfinished corners are later joined up accurately by the finisher, using an outlining tool. This is

generally done at the time the plate is being "spotted."

No account has been mentioned of the other machines, such as the saw for cutting wood and metal, the guillotine for cutting metal. the trimmer for truing up the blocks after cuts are mounted, the planer and type-high machine for planing down the blocks to proper thickness, the drill and jig-saw for mortising, etc., as these belong directly to the machine work and not connected with the actual "finishing."

Re-Engraving.

In many fine half-tones, especially in high class advertising cuts, we find various white lines tooled through backgrounds, high-lights, lighter middle-tones, etc., merely for artistic effect. These are tooled in by hand according to the talent and taste of the finisher. The work is known as "re-engraving", and being considered special hand work, is seldom done on a regular job unless so ordered, as "extra". It calls for more artistic skill and tasteful judgment than any other branch of finishing, and as the designs and patterns used are almost unlimited, careful study and patient practice are the best guides to it. The student in this art should learn to study the lines and patterns of other finishers' work and then build his own ideas along these lines. One suggestion, however: don't cut all the detail of the picture away by too much tooling. The result will be very distracting and unpleasant. Also, try to run the pattern in each separate division or subject of the plate with a different general direction, yet not too abruptly broken. Keep the tooled effect smooth and pleasing in appearance at all times.

Zinc Work.

Zinc finishing (line work) is practically "cleaning" the etchings of rough spots, irregular lines, etc., and the main tools used are the chisel and gouge. If a line is "chewed," routed into, dented by being struck, or otherwise broken, it can usually be repaired by

soldering and trimming up. The metal is first pricked up with a tool so the solder will hold, cleaned with "flux" (or hydrochloric acid cut with zinc), solder applied (using a soldering copper or jeweler's blow-torch), and then trimmed down to shape. Or, if the hole is not too large, the metal can be borne up well by jabbing into the sides of the line with a stout tool, then prying up slightly several times, rubbing the spaces full of soft wire solder, then burnishing down and trimming, much on the order of repairing a scratch in half-tone work. A small piece of "Scotch stone" is very useful in zinc work in polishing down an irregular surface.

"One picture is worth more than a million words, if the picture is right." —Brisbane.

PROVING

To save space, this chapter will be outlined in very brief form, yet as detailed as possible under the circumstances.

As the average customer cannot judge an engraving, especially a half-tone, from the plate alone, it is customary to submit a "proof" or printed impression on paper along with the job, showing the result the printer should produce from the plate. Most regular proving is done on a hand proof press, which consists principally of a flat iron "bed" on which the plate is laid for proving, a flat inverted "platen" under which the bed is moved along a track and a handle or lever by which the platen is forced down, imparting a great even pressure against the plate. There is also generally a "tympan", or canvas, stretched on a framework, hinged to the bed, acting as a cover for the whole work while proving.

In short, a small quantity of the proving ink, as bought, is rolled up on the glass, stone, or zinc slab for the purpose, using a regular composition proving or press roller. When the ink is properly distributed, the roller is passed several times over the plate, or "cut", leaving an even coating of the ink on its surface. The cut is then placed face up on the bed of the press (so as to centre the pressure), the paper adjusted on the cut and padded with several other sheets of paper or smooth cardboard, the bed slid under the platen, and the pressure applied. It is then released, and the paper pulled carefully from cut, with the ink design adhering to the paper. Care must be taken to use the proper kind and amount of ink, and just enough pressure to leave a clean complete proof without "punching" through the back of the paper sheet. Proving, (either Black-and-White or color), just as every other branch of engraving work, must be done with care and judgment, and a

fair knowledge of the materials used. If the proving is done on the power press (as color work often is) the same general rules apply, with necessary alterations of use.

Inks.

The exact details of the manufacture of printing and proving inks is more or less difficult to study thoroughly, partly on account of the secrecy in which the formulas and methods are held, and partly on account of the varied ingredients used in the manufacture as a whole by the different makers. The following will give a fair idea of the principal materials commonly used in ordinary black printing (or proving) inks:

Basic Ingredients—
Pigments:—Gas Black (for finest).
Lamp Black (for cheaper).
Vehicles:—Linseed Oil Varnish (for best).
Rosin Oil Varnish (for cheaper).
Petroleum Oil and Paraffine (for cheapest inks).
Subordinate Vehicles:—Gum Varnish,
Japan Drier,
Asphaltum,
Soap.

In ink tints, Zinc White is used for typographic Opaque inks, and Aluminum Hydrate for Transparent inks.

The principal pigments used in colored inks are divided into two general groups,—the natural mineral pigments, chemically compounded, and the coal tar dye products, known as "lakes". The former class includes most of the ordinary colors used in printing inks, but some of the purest and strongest colors, especially process red (3-color), are obtained from the latter class. These lakes are again divided into three classes, roughly, as to brilliancy and permanency. The most brilliant lakes are derived from analine dye (coal tar product), but are not so permanent as the other two weaker classes, which are from naphthalene and anthracene. So where per-

manency is a necessity in these colors brilliancy must be sacrificed to some extent.

There are several points to consider regarding the vehicle used in an ink, the most important being its drying qualities. The ink (especially process colors) should dry fairly rapidly in order to superimpose the different colors without great loss of time. Yet, too fast drying, especially on fine super-calendered proving paper, will cause the pigment to lie on the surface in the form of a loose powder. Linseed oil varnish is used in the best inks as the principal vehicle, having good drying qualities as well, as fine elasticity, thinner grades being used for fast press inks and the heavier for half-tone and hand press work.

In all cases, the ink, paper, and press used are infinitely related. An ink considered excellent for one sort of paper and press action might be worthless on another class of work.

General Suggestions.

Use good ink:—the best obtainable for the purpose. For half-tone proving a fine stiff ink rich in pigment is required. Roll up well and often in preference to "flooding" cut by using too much ink. Cheaper grade inks, containing too much oily base in proportion to pigment are not suitable for fine half-tone work. Ink too **soft** (different from lacking in pigment) can be stiffened by adding very little Sodium Silicate (ordinary water-glass). If too **stiff**, add "Reducing Varnish" (made by ink makers). Perfect half-tone proof should reproduce cut, dot for dot, in size and shape of dots. For line work (and coarse screen) a little more or softer ink can be used. All inks stiffer for hand press than for power press. Special "Driers" (made by ink makers) added when rapid drying is necessary.

Rollers:—Soft or medium composition for winter, hard for summer.

Sudden changes of atmosphere make trouble on ink and roller. Never use alcohol on roller; plenty of benzine and clean rags;

let dry before inking at once. Slight trace of benzine on roller or slab makes ink lay washy or greasy.

Tints:—Use "Tint Base" or "Mixing White". (See Printers' Color Chart). Tint base comes in heavy form (hand press) and thin syrupy form (power press). Use proper amount to produce the desired tint when cut is fed with proper amount of ink, without over- or under-inking. Do not use tint base and white in same mixing—will cause ink to lay mottled and uneven. Use base for transparent and white for opaque effects

Bronzing:—Gold or silver ink can be mixed and used as ordinary ink, with "Gold Varnish" (made by ink makers) and Gold Bronze or Aluminum Bronze. Difficult to handle, dries fast and hard, and will ruin rollers if not well cared for. Best work, also handiest for a few proofs, is procured by "Bronzing". For this, use "Gold Size" (made by ink makers), which is very much like yellow ink, but more adhesive; pull proof with this, then dust over with Gold or Aluminum Bronze, using large tuft of cotton.

Vignettes (Vin-yet):—Pull prove on about 3-ply litho board or "post card stock." Cut with sharp rounded knife or shears around edge, preferably just inside edge of job, shave off to gentle slope from bottom surface of card to inside edge of vignette at top surface. Success depends on careful cutting and shaving down. Glue in position on "tympan" to fit cut properly when in position for proving. (This can be done by first pulling impression on tympan sheet.) After paper stock has been placed over inked cut on press bed, tympan (with overlay) is placed down on it, pressure paper or padding on top of tympan, next to platen of press. Sometimes sheet (or two) of heavy proving stock between overlay and paper helps soften vignetted edge.

Movement or "Slur":—Double or elongated dots indicates movement of cut while proving. See that cut is centered for "pressure,' the heavier parts of printing surface

nearer centre of press bed than lighter detail parts with little surface. Try block (if cut is blocked) for uneveness or warp; if it rocks, build up with paper under low corners or place whole cut on several sheets of soft paper or blotter stock. See that plate is mounted solid and flat to block. Use bearers (height of wood) on sides.

Color Proving:—This is an art in itself, and the results depend considerably on the skill of the prover. While proving stop-out, tint-plate work, etc., belong to color-proving, this latter generally refers to process plates. The general notes on half-tone proving applies also to color work, and only a few brief additional suggestions will be given here.

All color-register work on hand press must be done by aid of a "register gauge," in which the blocked cuts fit evenly, and the paper is fed against three adjustable pins or guides so that each impression will fit in precisely the same position on each sheet. The pins are adjustable (by screw action) so that the paper, or first color impression, may be brought into "register" or super-position with the different blocks, allowing also of blocks being of different sizes if necessary. With power press this is accomplished by screw-adjusting gauge pins fastened into tympan sheet of platen. The lighter colors or tints are generally run first, the final impression being from the "key plate."

Duotones are proved (generally) tint halftone first, allowed to dry, and key plate halftone (or stronger color) superimposed on top, using "register gauge" or pins. If necessary a few approximate "register proofs" may be run in the colors wanted, so that the strength of tint desired can be judged better and also any extra tooling, etc., may be done on the plates before the final proving.

Three and four color work is handled the same in general, but more exactness is required. The inks (especially 3-color), strength of run, etc., must be uniform and

true. The yellow, being more opaque as well as generally found more or less as a body color over the whole job, is run first. This is the slowest drying of the process colors, but should be well dried before the next, the red (or magenta) is run. The blue follows, finishing the job in three-color work. It is semi-transparent, and dries fairly quickly. In four-color, the black is run last, except when using transparent process colors, then the order may be black, yellow, red and blue.

In any case, if the job is worth rendering in color process it is certainly worth doing well, and no pains should be spared in building up fine "over-lay" or "make- ready." Poor proving can ruin the result of an excellent color set, besides being misleading for any alterations the etcher decides to make on the plates. A good proof of a pleasing job should be a source of satisfaction to all concerned; from the customer and proprietor down to the errand boy who delivers the goods.

FORMULAS

Rubber Solution

Rubber cement (pure engravers') .. 5 ounces.
Benzole ..... 7 ounces.
OR
Pure Virgin rubber .....1 ounce.
Benzole .....about 32 ounces.

Stripping Collodion

Alcohol (grain) .....16 ounces.
Ether .....16 ounces.
Negative cotton .....300 grains.
Castor oil (best).....1 ounce.

Stripping Bath

Water ..... 24 ounces.
Acetic Acid (Commercial No. 8)...8 ounces.

Zinc Sensitizing Solution
(Ink Process)

Water ..... 8 ounces.
Albumen (white of one egg).....1 ounce.
(Or dried albumen powdered, 60 grs.)
LePage's Glue (for process works) ¼ ounce.
Ammonium Bichromate..... 20 grains.
Ammonia (stronger) .....¼ dram.

Reverse-Print Re-Developer

Water ..... 20 ounces.
Hydrochloric (strong) ..... ½ ounce.

Zinc Enamel

Water ..... 8 ounces.
LePage's Glue (for process work) 3½ ounces.
Ammonium Bichromate..... 120 grains.
Iron and Ammonium Citrate .... 20 grains.
Ammonia ..... ½ dram.

Enamel Hardening Solution

Water ..... 16 ounces.
Chromic Acid ..... 20 grains.
OR

Water ..... 60 ounces.
Chrome Alum ..... ½ ounce.
Tannic Acid ..... ¼ ounce.

OR (to be used in etching bath)

2½ drams Chrome Alum to 40 ounces bath.

Copper Enamel (Glue)

For general work

Water ..... 8 ounces.
Albumen (whites of 2 eggs) ..... 2 ounces.
LePage's Glue (for process work) . 3 ounces.
Ammonium Bichromate ..... 120 grains.
Ammonia (stronger) ..... ½ dram.

Copper Enamel (Gum)

(soft working, for color work)

Water ..... 8 ounces.
Gum Arabic ..... 1 ounce.
Ammonium Bichromate ..... 60 grains.
Albumen (whites of two eggs) .... 2 ounces.
Ammonia ..... ½ dram.
(Dissolve gum, over night, in 6 oz. water, add bichromate in 1 oz. and albumen beaten in remaining oz. Add ammonia, beat and filter

Dye Solution

Analine (violet) .....20 grains
Denatured alcohol .....¼ ounce
Water ..... 16 ounces
Dissolve analine in alcohol, then add water.

Scum Remover

Water ..... 16 ounces.
Potassium Permanganate .....30 grains
Hydrochloric Acid (Commercial) .. ½ ounce.

OR

Water ..... 16 ounces.
Acetic Acid (No. 8) ..... 12 ounces.
Salt ..... 4 ounces.

OR

Water ..... 16 ounces.
Chromic Acid (crystals).....1 dram
Hydrochloric Acid (Commercial.....½ ounce

Chalk Remover

Water ..... 16 ounces
Hydrochloric Acid (Commercial).....1 ounce
Salt ..... 4 ounces.

OR

Water, Acetic Acid and Salt; same as scum remover.

Etching Bath for Copper

Perchloride of Iron crystals dissolved in earthenware jar, add water to test 40 degrees Baume. Strain through cloth before using.

OR

Carboy iron, as bought.

Staging Ink.

Asphaltum ..... 3 ounces.
Printers' Ink (cheap grade).....1 ounce.
Bees-wax (or tallow) .....½ ounce.
Thin with turpentine as used.

Enamel Remover.

(For removing enamel from etched plates.)
Potassium Cyanide (sat. sol.)

OR

Potassium Cyanide (sat. sol.) and Lye (sat. sol.) equal parts.
Heat plate and scrub with solution.

WEIGHTS AND MEASURES

Apothecaries' Weight. (used in formulas)

20 grains .....1 scruple.
3 scruples .....1 dram. (60 gr.)
8 drams .....1 ounce. (480 gr.)
12 ounces .....1 pound. (5760 gr.)

Avoirdupois Weight. (used in buying)

27.34 grains ..... 1 dram.
16 drams.....1 ounce. (437½ gr.)
16 ounces .....1 pound. (7,000 gr.)

Fluid Measure

60 minims ..... 1 dram.
8 drams .....1 ounce.
16 ounces ..... 1 pint.
2 pints ..... 1 quart.
4 quarts ..... 1 gallon.

Metric System. (French)

1 gramme ..... =15.43 grains.
1 cubic centimeter (water) = nearly 17 minims (16.896) and weighs 1 gramme.
1 meter ..... =37.37 inches

Printers' Measure

72 points ..... 1 inch.
12 points.....1 pica em
6 pica ems ..... 1 inch
13 pica ems ..... 1 column

Paper Measure

24 sheets ..... 1 quire.
20 quires ..... 1 ream
10 reams ..... 1 bale.

A Few Chemicals, Their Synonyms and Brief Explanations

(C. P.=Chemically Pure—U. S. P.=United States Pharmaceutical Standard)

Acid—Most acids change blue litmus paper to red.
Should be kept in glass-stoppered bottles, except Hydrofluoric, which requires wax or lead containers.

Acid=Acetic (absolute)=100 per cent.

Acid—Acetic (glacial)=80 per cent-99 per ct.

Acid—Boracic=Boric.

Acid—Citric—found in juice of lemons, etc.

Acid—Nitric (C. P.)=Aqua fortis.

Acid—Nitric (commercial)=38 per cent-40 per cent.

Acid—Sulphuric (C. P.)=Oil of Vitriol.

Acid—Sulphuric (commercial)=66 per cent.
***Sulphuric acid should always be poured into cold water, never the water into the acid, as there is thus danger of explosion.

Acid—Tannic=Tannin.

Albumen=White of Egg=(also in powdered form). (60 grs. powdered=1 oz. fresh)

Alcohol—(grain)=rectified spirit.

Alcohol—(wood)=methylated spirit (poison).

Alcohol—(denatured)=mixture of grain and wood alcohols.

Alkalies=caustics (sodas, potash, ammonia, etc.) change red litmus paper to blue.

Aqua Ammonia=Water of Ammonia=Stronger Ammonia. (Composed of nitrogen and hydrogen.)

Aqua Fortis=Nitric Acid.

Asphaltum=asphalt=bitumen=Jew's pitch.

Bicarbonate of Soda=Sodium Bicarbonate=Baking Soda.

Bichloride of Mercury=Corrosive Sublimate. (Very poisonous.)

Bichromate of Ammonia=Ammonium Bichromate. (All chromates are more or less sensitive to light.)

Bichromate of Potash=Potassium Bichromate.
Calcium Hydrate=Lime.
Calcium Carbonate=Limestone.
Carbonate of Soda=Sodium Carbonate=Sal Soda.
Carbonate of Potash=Potassium Carbonate=Salts Tartar. (Can be used for refining silver waste.)
Copper Sulphate=Sulphate of Copper=Bluestone=Blue Vitriol.
Cyanide of Potash=Potassium Cyanide. (A most powerful poison.)
Ether—prepared by distilling alcohol and sulphuric acid and rectifying the result over slacked lime.
Ferricyanide of Potash=Red Prussiate of Potash.
Ferrocyanide of Potash=Yellow Prussiate of Potash.
Formalin=40 per cent Formaldehyde.
Iron Chloride=Perchloride of Iron.
Potassium Hydrate=Caustic Potash.
Potassium Permanganate=Permanganate of Potash.
Pyroxyline = Guncotton = Nitro-cellulose. (cotton treated with nitric and sulphuric acids).
Sodium Chloride=Common Salt.
Sodium Hydrate=Caustic Soda.
Sodium Nitrate=Chile Saltpetre.

Water Tests.

Lime: Two drops of strong oxalic acid solution in a glass of water. If milky, lime is present.
Alkalies—Immerse red litmus paper. No change indicates no alkali.
Carbonic Acid—Add equal parts of lime water. A precipitate indicates carbonic acid; now add muriatic acid and it will effervesce.
Iron—Add prussiate of potash. Blue color indicates iron.

MISCELLANEOUS

Ben Day

The "Ben Day" Process, invented by a man of that name, is a rapid mechanical method of laying tints in ink on metal prints, drawings, line negatives, etc., so as to produce those tint effects in the etched plates (usually line zinc work). A "Ben Day film", of suitable pattern in relief, is rolled up with Ben Day or etching ink. The film is then inverted on the metal print (or other surface to be Ben Dayed), held in position by the "Ben Day Machine", and the inked relief design transferred by pressure of a small roller or "stylus". Parts not to receive the design must have first been painted over with gum gamboge, opaque, or Chinese white; after the tint is laid this is washed off with water, carrying the ink with it. The design on the bare metal remains. The print is then topped and etched as usual.

Stop-Out Work

The developed ink print is "stained" by passing a few seconds in a weak etching bath, allowed to oxidize, rinsed off, and dried. The parts not wanted in that particular color in which the plate is to be printed are rubbed off with ammonia, or just under water, using a bit of cotton wound on a small stick; or the whole plate may be cleaned off with gasoline or ammonia, leaving only the stained print. Parts wanted are then painted up solid (etching or staging ink), or Ben Dayed, and plate topped and etched as usual. On large work, negative is sometimes opaqued for successive colors to remove parts not wanted.

Reverse Print

Print (Ink) and develop as usual, but do not "top". Pass through etching or graining bath as in staining, but little more. Roll up

solid with etching ink. Re-develop in Reverse Print Developer (see formula). The solution dissolves sensitizer on plate, but ink adheres to the bare grained surface. Ammonia can be used instead of the acid solution if desired. Another method is to paint over with shellac and reverse by soaking in turpentine.

Most work in this effect is done by printing from a "positive" instead of from a negative.

Line Work Cut With Screen

Strip line negative. Strip over it film of "screen negative" (shadow-dot, made with "flash" exposure; one-way screen, made with "slit stop", etc.). Cut and remove parts of screen film not wanted. Print and etch as usual.

Screen Rulings

60—fast rotary news presses.
85—flat-bed news, and large "circular" work.
100—medium grade pamphlets and booklets.
120—ordinary book work.
133—ordinary book and catalog work.
150—fine grade book and catalog (good paper).
200—finest printing on good paper stock; (microscopic reproductions, etc., where detail is essential.)

Combination (Line and Half-tone)

Strip line negative. Strip over it half-tone negative in position. Cut through both films. Remove under (or line) film, replace H. T. in space, foining carefully, and blot down. Any inserts can be stripped into H. T. in same manner. Print as usual. Etch half-tone (complete), then paint in solid and etch line work down.

Double Print

Strip line negative and half-tone negative on separate pieces of glass, plenty large enough to cover metal. Place cut metal in position on largest negative, and glue three small bits of cardboard onto glass, two along one side and one at end of metal, for register guides. Place negatives (on glass) one over other in register. Now glue three more bits

of cardboard on second glass directly over, or in register with, the first three pieces. Print from one negative, having metal evenly against the three guides, then print from the other negative (regular time on each) with metal in same position. Develop and etch as usual.

Tint Plates

Etch regular half-tone plate as usual; best a shade lighter where tint is wanted. Print from same negative onto zinc (either ink or enamel process; if enamel, just dye and dry off, but do not burn in). Or, print can be transferred to zinc, by pulling heavy proof from H. T. plate on good paper, and transferring from paper onto zinc, in proof press. Zinc print is then outlined or tooled around parts where tint is wanted, the rest routed away and trimmed up as usual. Proved, in register, with half-tone proof.

Embossing

Transfer proof from half-tone, or other "key" plate (as for tint plate), on heavy type-metal or brass for the purpose. Tool parts to be embossed in "intaglio", or sunken design, into the metal. Deeper cutting gives higher relief in embossing. Tool with as broad smooth-blending effect as permissable, avoiding sharp cutting corners that are apt to cut the paper. Prove by squeezing into several thicknesses soft damp blotter. Printer builds us "matrix" or "male die" by spreading compound on platen of press, pulling relief impression from plate, and allowing to "set" hard. Then prints as usual (but no ink or roller used), paper being squeezed into relief design between matrix and plate (or male and female dies). If plate, or die, is cut in soft type metal, it is only used as a pattern from which a heavy "electrotype" is made for embossing on the press. Dies can also be etched, using a "positive" or the reverse print method.

Spliced Negatives

Sometimes we are required to make a cut (line or half-tone) larger than the capacity of our camera. Make a negative of each half of the copy, including a little more than half on each negative to allow for lap in matching up. Strip the two halves together in register, allowing the surplus ends to overlap and coincide. Cut through both films at one time, after blotting down. cutting as few lines of the design as possible. Remove cut ends and work films smoothly together with small piece of blotter.

Clarified Glue

Any good glue could be used for organic matter in sensitizing solutions and enamels were it not for being contaminated with greases. These greases can be removed (for emergency use) by clarifying as follows: soak ½ lb. good ordinary broken glue until soft through (about 21 oz. water). Add whites of two eggs and three oz. ammonia. Let come to slow boil over fire until eggs coagulate, skimming off scum that rises. Strain through cheese cloth and allow to cool.

In successful experiments, as above, granular sizing glue was used, although good cabinet glue is best. The "Duotone" prints in Appendix were made with this clarified glue enamel.

Roller Compound

For composition proving and printing rollers: 1 lb. glue (common), 1 qt. best sugar-house syrup, 1 pt. glycerine. Soak glue in distilled water until soft. Melt over slow fire; add syrup; boil for half-hour, skimming off scum. Add glycerine and boil few minutes longer. Pour into mould around centered roller stock, let stand day or two, and draw from mould ready for use.

Rough dirty spots in copper half-tone plates can sometimes be smoothed up by

scrubbing with ½ nitric acid and ½ water, using stout re-etching brush or rubbing over with flat piece of wood.

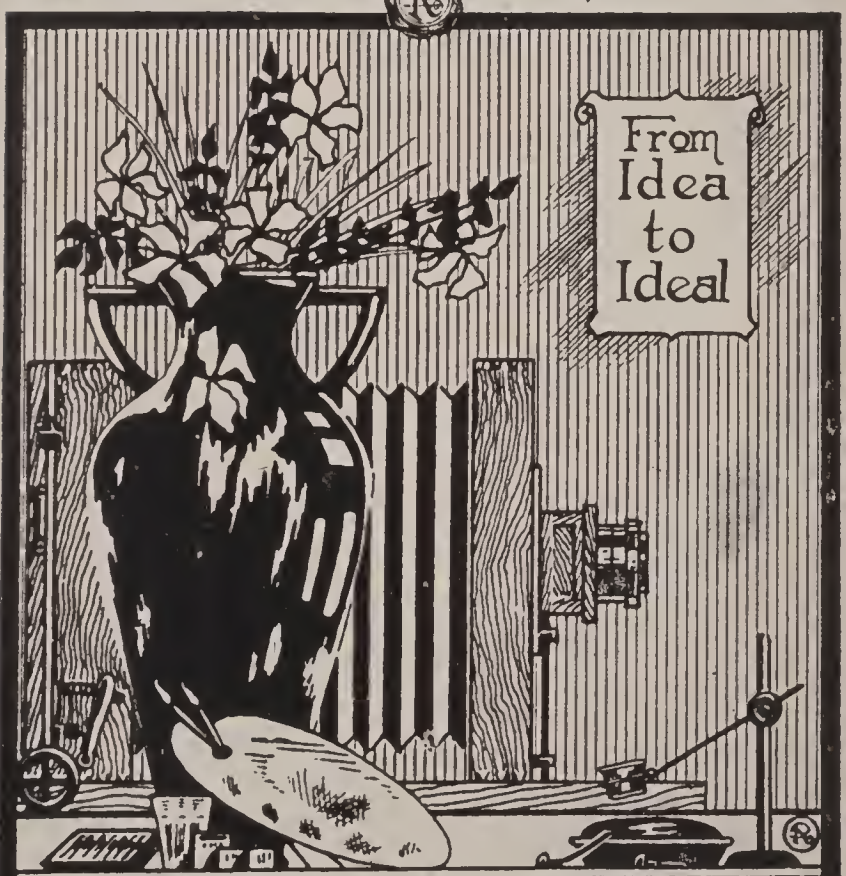
Zinc plates can be kept smooth and bright in etching by adding ½ oz. of either Glue Gum Arabic, or Galic acid to every 40 oz. etching bath.

INDEX

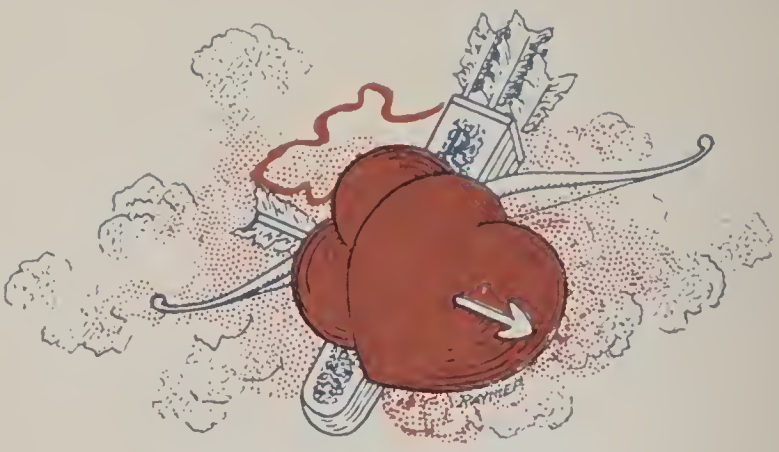
APPENDIX
OF EXAMPLES—
IN
COMMERCIAL PHOTO-ENGRAVING

Designed, Engraved & Printed by

·P.C.RAYMER·



Example of Zinc Etching;
(with Ben Day Shading)



Stop-Out Color Zinc
with "Ben Day"

RUSH

Direct Zinc Print

RUSH

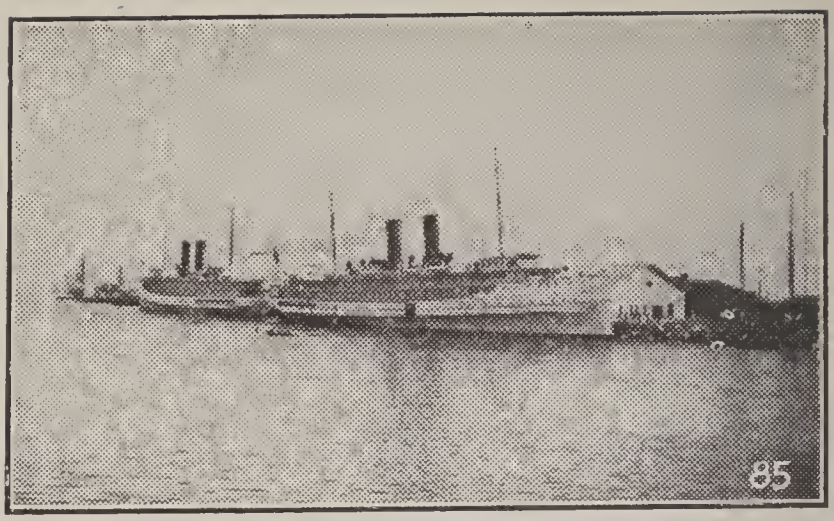
Reverse Print Effect

REVERSE PRINT.

RUSH

Line Etching Cut With Screen
(Stripped-Over Screen Neg.)

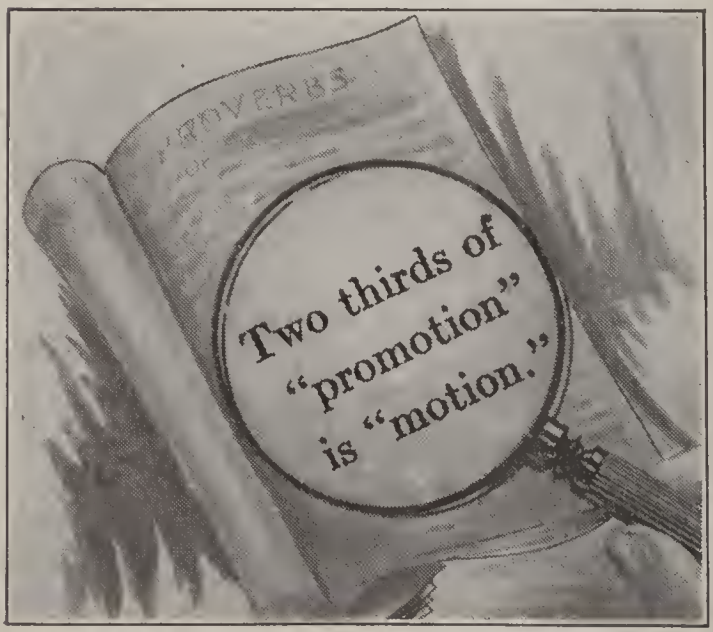
Half-Tone (60 screen) on Zinc
(Newspaper Half-Tone)



SCREEN RULINGS
in commercial use.

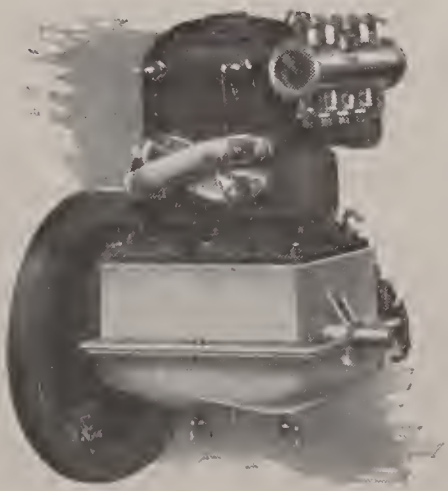
SCREEN RULINGS
in commercial use.

COMBINATION Line & H.T.
(with Insert)



DOUBLE PRINT

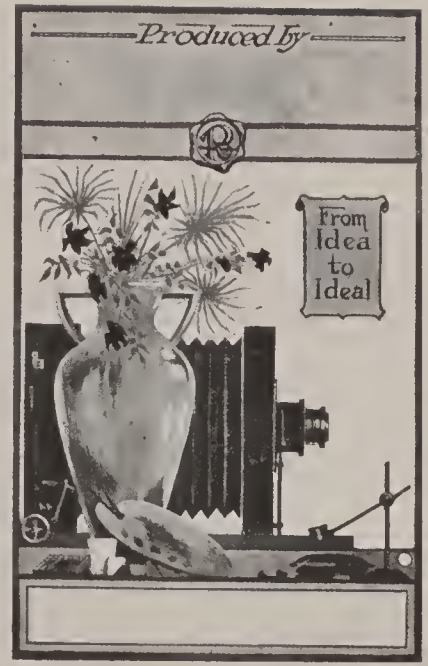
Half-tone with Tint Plates:-
showing Cut-away Background
and Soft Vignette.
Gold Plate;-solid zinc,
Pink Plate;-solid zinc)cut
Black " ;-H.T.on Copper.



Showing "Hard Vignette"
or "Hard Shadow".

DUOTONE-
(2-color H.T., "fake")
(from B.& W. photo.)

Yellow Plate



Red Plate

Blue Plate

Black Proofs of 3-color Process Plates.

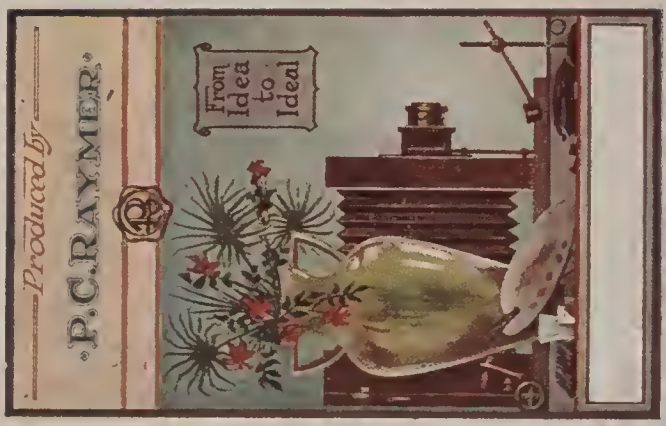
A


Produced by
From Idea to Ideal

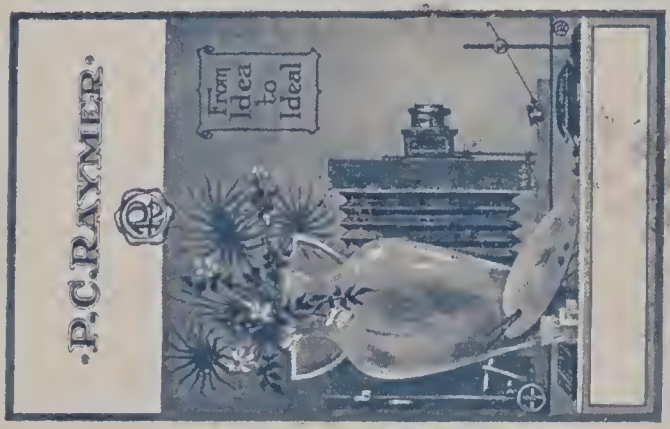
B


Produced by
From Idea to Ideal

C



E



D

The Evolution of a
3-color Process Print.

(a) Yellow impression.
(b) Red impression.
(c) Red impress. over Yellow
(d) Blue impression.
(e) Blue over Yellow and Red
(=Finished Result)

Example of 4-color Process Work.
(showing 4-color Inks used)

Embossing Plate.
(hand-cut)


THE LIBRARY OF CONGRESS